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ABSTRACT

A comprehensive mathematics program for grade 3 is presented in 66 units. These units are organized around four central themes: (1) number and numeration; (2) operations with numbers; (3) geometry and measurement; and (4) algebraic concepts, graphs, probability, statistics, and problem-solving. A spiral approach is used with various topics being indexed as to unit and page. Specific learning experiences are suggested for each unit. Suggested use of mathematical laboratory materials is found throughout. (MP)

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Mathematics

GRADE 3

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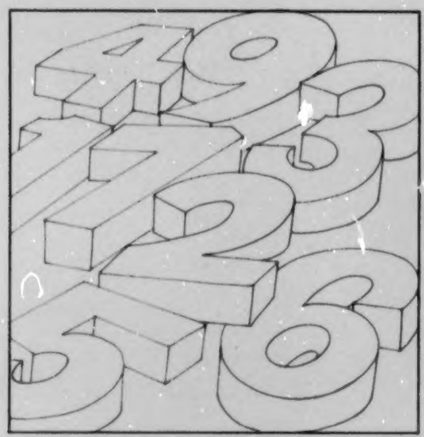

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FOREWORD

The Mathematics: Grade 3 Curriculum Bulletin is one of a planned series of bulletins designed to extend, strengthen and refine the computational skills, mathematical understandings and problem solving abilities of all pupils involved in elementary mathematics.

This bulletin presents both the scope and sequence of activities for implementing the New York City mathematics program at Grade 3. Much consideration is given to the individual learning styles, the diverse mathematical needs and the unique rates of mastery of all our pupils, thus the material was planned to assist teachers and supervisors to meet these needs.

The activities reflect current mathematical ideas and are designed to help teachers and pupils gain new insights into mathematical content. It is hoped Mathematics: Grade 3 will serve as a vehicle in providing a systematic and continuous mathematics program that is relevant, logical, useful, effective and exciting for all the New York City youngsters.

Arnold Webb
Executive Director

ACKNOWLEDGMENTS

The curriculum bulletin, Mathematics: Grade 3, Scope and Sequence Teaching Manual was prepared as a project of the Division of Educational Planning and Support, Arnold Webb, Executive Director.

Leonard Simon, Assistant Director (Retired) Curriculum Development; Charlotte Frank, Head of the Curriculum Planning and Policy Unit; George Grossman, Director, (Retired) and Frank Wohlfort, Assistant Director of the Center for Mathematics and Science provided overall supervision.

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Grateful acknowledgment is made to Dorothy Silverman and Sylvia Somerville who served as administrators of the curriculum writing program.

Tom Vega, Unit Head, Dissemination Unit, supervised the production and distribution, Joseph Feld was responsible for the overall graphic design of the book and Daniel Soler prepared the illustrations.

We wish to acknowledge the fine contributions of those teachers who field tested this manual and whose cooperation and suggestions helped guide the revisions. The teachers represented the following school districts: 1, 2, 4, 8, 10, 12, 13, 15, 16, 17, 19, 20, 24, 24, 26, 28, and 29.

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Introduction

Mathematics: Grade 3 was prepared to assist teachers and supervisors in implementing the mathematics program of Scope and Sequence - Grade 3.

The scope of mathematics for Grade 3 is presented in 66 units, each of which may require one or more lessons. These units are organized around four central themes and are coded as shown below:

*	Number; Numeration
**	Operations with Numbers
***	Geometry and Measurement
****	Algebraic Concepts; Graphs; Probability; Statistics; Problem Solving

Mathematics: Grade 3 is presented in a spiral or cyclical arrangement for the following reasons:

- to provide for continuous development and reinforcement throughout the year
- to develop ideas gradually based upon simpler aspects
- to show the interrelationships of ideas
- to review, maintain, and extend skills

Specific learning experiences for children are suggested for each unit. The teacher may choose those activities which he considers most helpful for a particular class, group, or individual. Where a direction such as "join," "draw," "arrange," is given, it is meant as a pupil's activity.

Recommended use of mathematics laboratory materials, usually available in schools, is found throughout this publication. However, no attempt is made to be prescriptive. Many teachers will substitute other materials or pupil-made materials.

In the spiral approach, you will find, for example, that Multiplication of Whole Numbers (Basic Facts) begins in Unit 7, and continues in Units 15, 27, 35, 40, 43, 49, and 53. Units 55, 58, and 59 reinforce the basic multiplication facts and develop the algorithm for multiplication.

The suggestions in this publication are designed to help the teacher present a mathematics program which will be meaningful to the pupil, will help him think through mathematical relationships, and will enable him to achieve functional competency. In each school, the needs of the pupils should guide the teacher and supervisor in the adaptation of these materials.

Basic Mathematics Laboratory Equipment

Various manipulative materials are recommended for use in implementing the 66 units. To provide a brief overview of some specific mathematical concepts derived from these materials, the following is presented.

Abacus

Counting; grouping; numeration; place value.

Attribute Blocks

Classification; set concepts; logic; number operations; patterns; polygon construction.

Beads on a lace and/or tens frame

Counting; estimation; basic number facts; number operations; graphs; patterns.

Calculators

Counting; place value; addition; subtraction; multiplication; division; mathematical sentences; principles of number operations; problem solving.

Colored Rods (Cuisenaire)

Classification; ordering; estimation; equalities, inequalities; mathematical sentences; counting; place value; odd and even numbers; patterns; addition, subtraction, multiplication, and division of whole numbers; basic number facts; fractions; metric system; polygons - construction, names and/or properties; symmetry; perimeter; area; graphs; construction of 3-D shapes.

Discs (plastic and/or paper)

Counting; estimation; basic number facts; number operations; fractions.

Geoboards

Point; line segment; parallel lines; intersecting lines; angles; polygons - construction, names and/or properties; area; perimeter.

Counting; number; patterns; multiplication; division, odd and even numbers; fractions.

Mathematical Balance

Counting; equalities; inequalities; mathematical sentences; basic number facts; number operations; operations with fractional numbers.

Multibase Arithmetic Blocks

Counting; estimation; place value; patterns; addition; subtraction; multiplication; division.

Pattern Blocks

Counting; estimation; patterns; addition; subtraction; fractions; linear measurement; polygons - construction, names and/or properties; symmetry.

Squared Materials

Counting; equalities; inequalities; mathematical sentences; numeration; patterns; place value; addition, subtraction, multiplication, and division algorithms; graphs; measurement.

Tangrams

Counting; fractions; polygons - construction, names and/or properties; symmetry.

Unifix Cubes or Interlocking Cubes

Ordering; counting; estimation; place value; groupings; patterns; mathematical sentences; basic number facts; addition; subtraction; multiplication; division; graphs.

The following is presented to provide a brief overview of the mathematical understandings and skills for Grade 3.

Mathematical Understandings for Grade 3

1. Number; Numeration

   Count by thousands to ten thousand (and beyond)
   Understand place value and record in expanded notation to 1000
   Round numbers to nearest hundred

2. Addition

   Algorithm: vertical format, two addends, sums through 999, two exchanges
   Column addition: more than two addends, sums through 999, with exchange
   Addition in dollars-cents system
   Addition and subtraction as related operations
   Observe and use commutative and associative properties of addition

3. Subtraction

   Algorithm: vertical format, regrouping one hundred for 10 tens, one ten for 10 ones
   Subtraction in dollars-cents system
   Subtraction as comparison - difference; missing addend

4. Multiplication

   Basic facts
   Algorithm: vertical and horizontal format, number named by two-digit numeral multiplied by number named by one-digit numeral, with and without exchange
   Observe and use the commutative property of multiplication, the distributive property of multiplication over addition, the role of 1 and 0 in multiplication

5. Division

   Basic facts
   Algorithm: vertical and horizontal format, divisors 1 - 9, dividends 99 or less

6. Fractional Numbers

   Concept: sixths, eighths of a whole
   Finding $\frac{1}{6}$, $\frac{1}{8}$ of a number of things
   Equivalence: halves, thirds, sixths
   halves, fourths, eighths

7. Geometry

Concepts: curve, closed curve, simple closed curve, polygon
Properties of plane figures: quadrilateral, rectangle, square, triangle
Line symmetry

8. Measurement

Linear: yard, meter, centimeter
Capacity: gallon, liter
Weight: ounces in a pound, ounces in $\frac{1}{2}$ and $\frac{1}{4}$ of a pound, kilogram, gram
Time: clock - 5-minute intervals, A.M., P.M.
calendar - number of weeks in month, writing date - month, day, year
Temperature: above and below zero degrees on a Fahrenheit thermometer
above and below zero degrees on a Celsius thermometer

9. Other Content Included

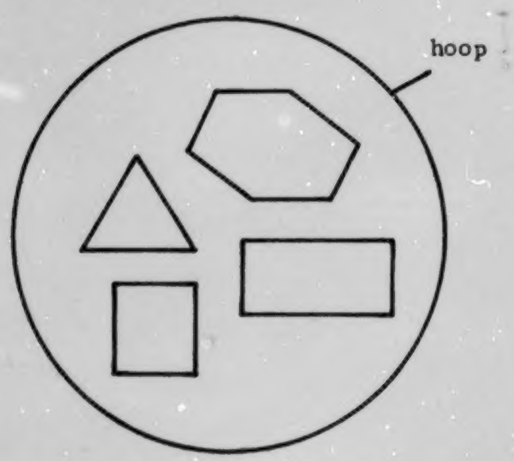
Bar graphs, concepts from sets, algebra, probability and problem solving.

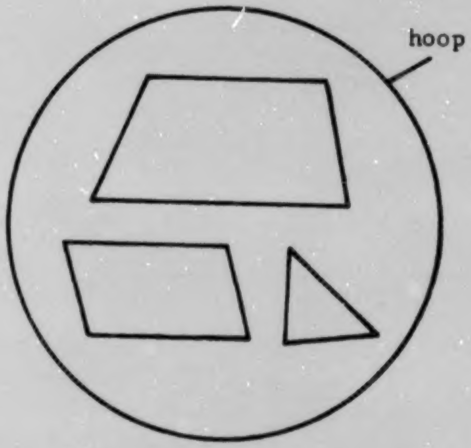
*UNIT I. NUMBER

Use physical objects to review the concepts of sets which strengthen the idea of "number:" meaning of a set, members of a set, and number property of a set.

Suggestions for Pupil Activities

Sort a collection of geometric shapes such as attribute blocks, pattern blocks, paper shapes, geoblocks, colored rods, buttons, and stones into sets (groups).





1. Describe each set formed in different ways.

Some possible descriptions may be:

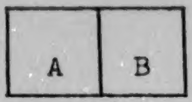
It is a set of shapes with straight edges.
It is a set of a triangle, a hexagon, a square, and a rectangle.
It is a set of red shapes.
It is a set of thin shapes.
It is a set of four shapes.

2. Determine the number of objects in each set.

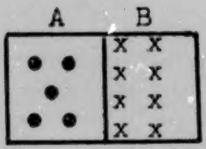
3. Compare the number of each set.

$4 > 3$	$3 < 4$
4 is greater than 3	3 is less than 4

Make paper models of sets by folding a sheet of paper in half.



Use dots and X's to represent given sets of numbers and make comparisons.



Fold the paper so that only one side shows at a time and establish the number of each set.

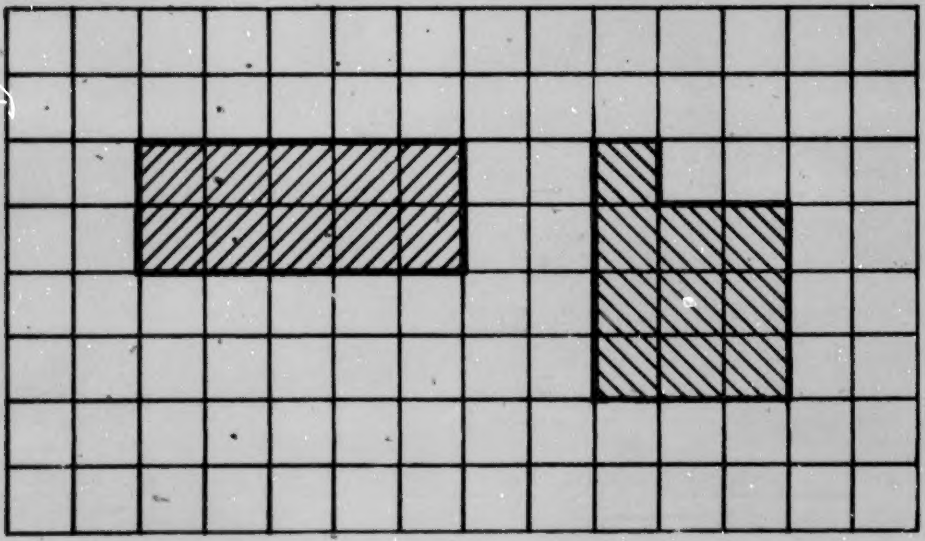
How many dots in the the first set? Call it Set A.
How many X's in the other set? Call it Set B.
How many dots and X's?
Number of dots + number of X's = ☐

$5 + 8 = \square$

Are there more dots than X's?
Write sentences to show comparisons.

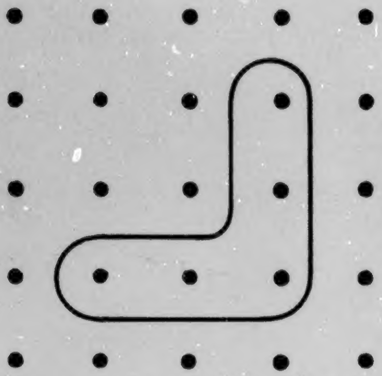
$5 < 8$, $8 > 5$

Using graph paper, show sets of 10 boxes.



Make as many sets of 10 as you can.

Use geoboards (or dot paper) to reinforce the number property of a set.



Think of geoboard (or 5 by 5 array of dots) as a set of nails.

How many nails in the set?
How many nails in each column?
How many mails in each row?
How many nails in 3 rows?
How many nails in Set A?

Make other sets using rubber bands and answer "how many..."

****

UNIT 2. GRAPHS: BAR GRAPH

Use experience situations to construct and interpret bar graphs.

Suggestions for Pupil Activities

A teaching sequence for the development of bar graphs follows:

1. Have pupils work in pairs or in groups and collect data and record in various ways.

Topic: Our Favorite Colors

Carl	- yellow
Scott	- blue
Peter	- red
Elizabeth	- yellow
Gail	- yellow
Adam	- blue
Jean	- yellow
Tom	- red
Frances	- red
Philip	- orange
Andrew	- green

Green	Red	Blue	Yellow	Orange
Andrew	Peter	Scott	Elizabeth	Philip
	Tom	Adam	Gail	
	Frances		Jean	
			Carl	

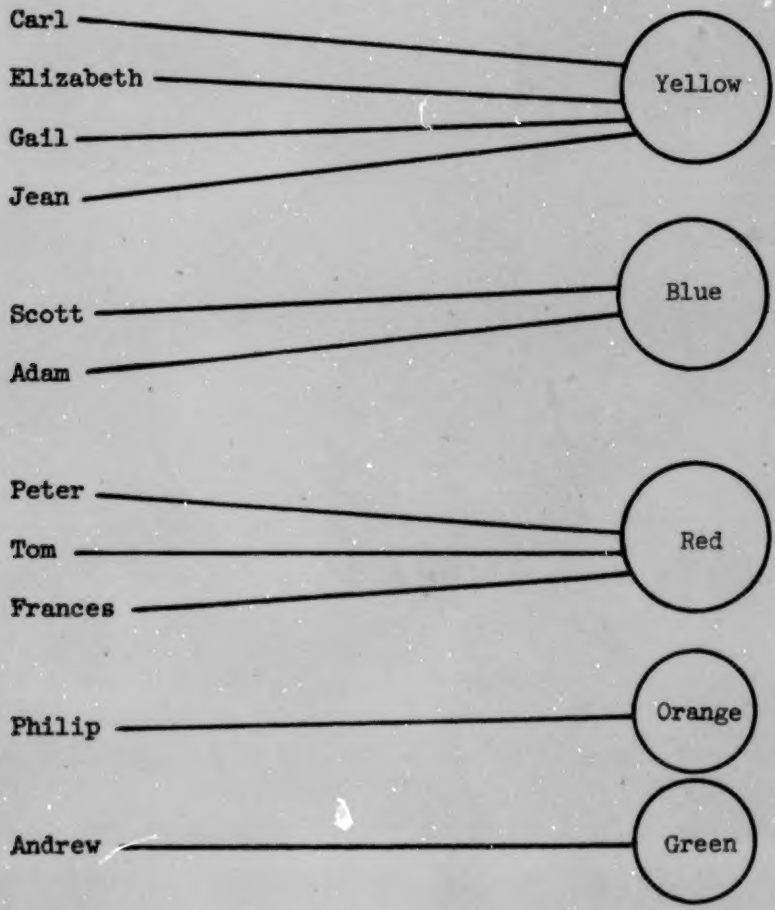
Orange - Philip
Red - Peter, Tom, Frances
Green - Andrew
Yellow - Elizabeth, Carl, Gail, Jean
Blue - Scott, Adam

Discuss and interpret the information listed.

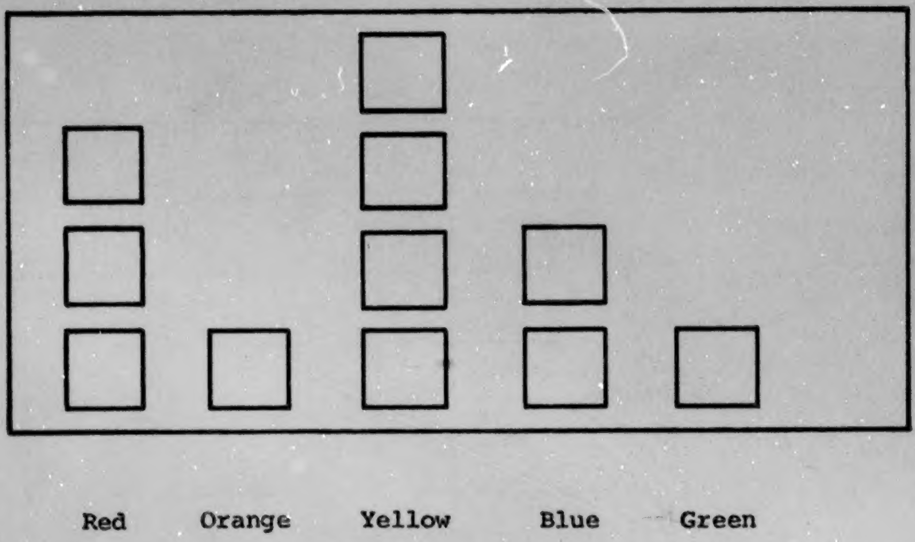
How many children chose a favorite color?
How many favorite colors are there?
Which is the most popular color?
Which is the least popular color?

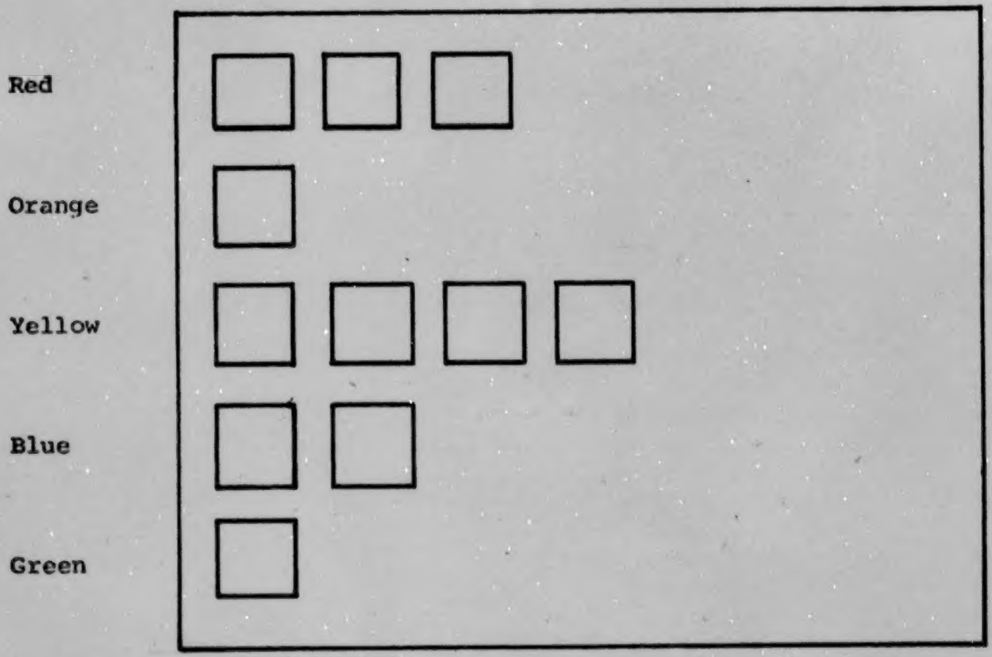
2. Organize data in ways that will make it easier to read and compare the information.

a. Mapping



b. Placing colored squares in rows and columns.

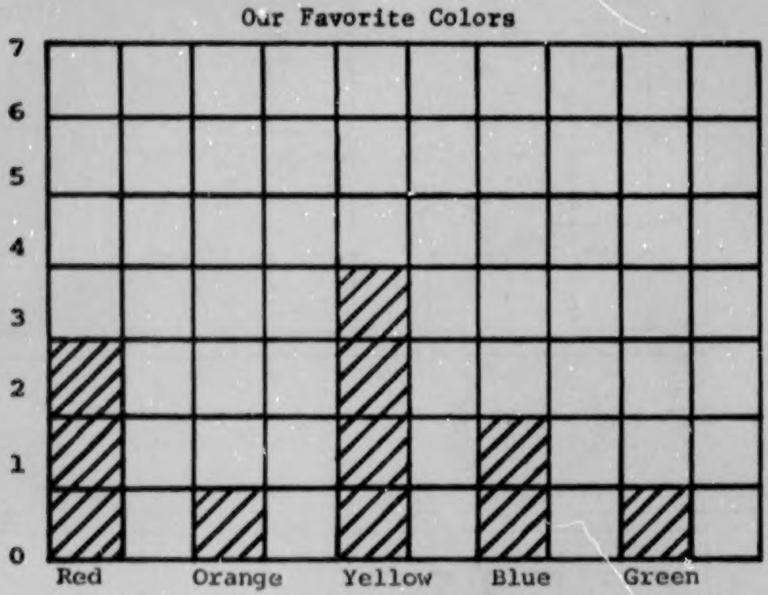




Discuss why it is easier to read the information when data is organized in rows and columns.

3. Use graph paper to picture data in the form of a bar graph. In the development include ideas such as:

- need for a title
- need for labeling the horizontal axis and the vertical axis
- bars may or may not have space between them
- uniformity of width of the bars



Derive mathematical sentences from the graph, e.g. $3+1+4+2+1=11$ $4 > 3$. Write word problems about the graph. Write questions which can be answered by studying the graph, e.g. which column is the longest? Which column is the shortest?

Some topics that can lead to graph construction:

Children Who Wear Glasses and Those Who Don't
Favorite Pets
Most Popular TV Shows
Test Marks
Streets Where We Live
How We Get To School
Nationalities
Favorite Hobbies
Favorite Songs
How the Day is Spent
Children's Names
Favorite Toy
Birthdays Graph

****

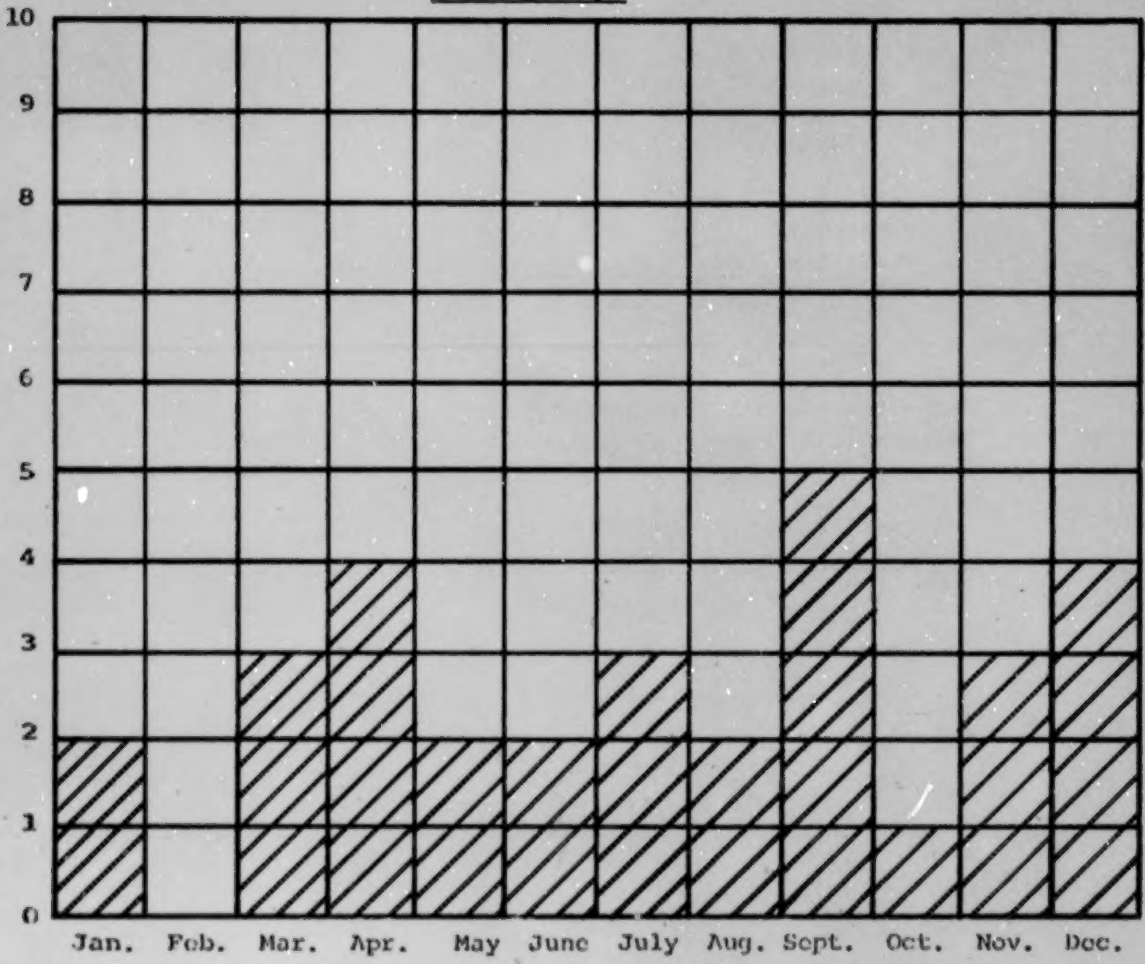
UNIT 3. MATHEMATICAL SENTENCES

Reinforce concept of mathematical sentence: use of placeholder(s), use of symbols +, -, =, >, <, to write number stories as mathematical sentences. Use symbol ≠ .

Suggestions for Pupil Activities

Provide opportunities to construct graphs using children's birthdays, favorite colors, pets, fruits, streets where we live, etc.

Our Birthdays



1. Interpret the graph and make comparisons which involve use of the symbols >, < .

Ask: Are there more birthdays in March or April?
How many birthdays are there in March? (3)
How many birthdays are there in April? (4)

Which number is greater?
Which number is less?
Express the relationship in mathematical sentences.

$4 > 3$ Read as: 4 is greater than 3

$3 < 4$ Read as: 3 is less than 4

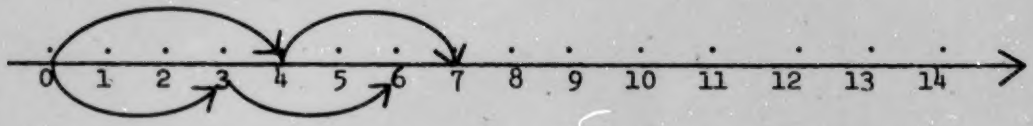
2. Write open sentences for finding:

   a. the total number of birthdays in the first three months: $2 + 0 + 3 = \square$; in the last three months, $1+3+4 = \square$

   b. the difference between the number of birthdays in January and April, $2 + \bigcirc = 4$ or $4 - 2 = \bigcirc$. Therefore, there are 2 more birthdays in April than in January.

3. Introduce $\neq$ (is not equal to) as another symbol for inequality.
   Where the number is the same, record as $2 = 2$.
   Where the number is not the same, record as $5 \neq 1$.

Demonstrate equalities and/or inequalities on number lines. Write mathematical sentences to express the relationships.



$3 + 3 \neq 4 + 3$ $3 + 3 < 4 + 3$

$4 + 3 > 3 + 3$

**

UNIT 4. ADDITION OF WHOLE NUMBERS

Reinforce basic facts, sums through 18. Include the following ideas:

a. Addend + addend = sum
b. Construct addition table
c. Observe and use commutative and associative properties of addition
d. Role of zero as the identity element of addition
3. Column addition, three or more addends

Suggestions for Pupil Activities

Complete charts

Addend	6	7	6						
Addend	3	7	0						
Sum	9								

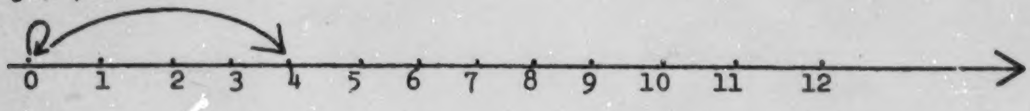
Summarize the basic addition facts on duplicated outlines of addition tables. Name the missing sums in the boxes where the row and the column meet.

+	0	1	2	3	4	5	6	7	8	9
0										
1										
2								9	10	
3										
4							10			13
5					9	10			13	
6				9				13		
7			9	10			13			
8										
9					13					

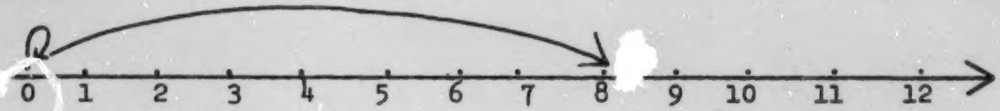
Use a completed addition table. Locate the sums for 6 + 7 and 7 + 6; 9 + 4 and 4 + 9; 8 + 5 and 5 + 8; etc. Discuss the fact that changing the order of the addends does not alter the sum (commutative property for addition of whole numbers). Name the different sums for 13, e.g., 9 + 4, 8 + 5.

Use a series of number lines.

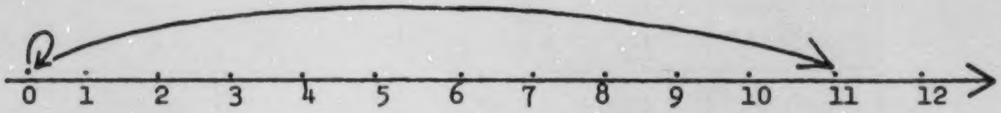
0 + 4



0 + 8



0 + 11



etc.

Write equations describing the number line pictures.

$0 + 4 = 4$
$0 + 8 = 8$
$0 + 11 = 11$
etc.

Conclude: When zero is one of the addends, the sum is the other addend (identity element of addition).

Select any three numeral cards.

$\boxed{4}$ $\boxed{2}$ $\boxed{7}$

Arrange them in any order and find the sum.

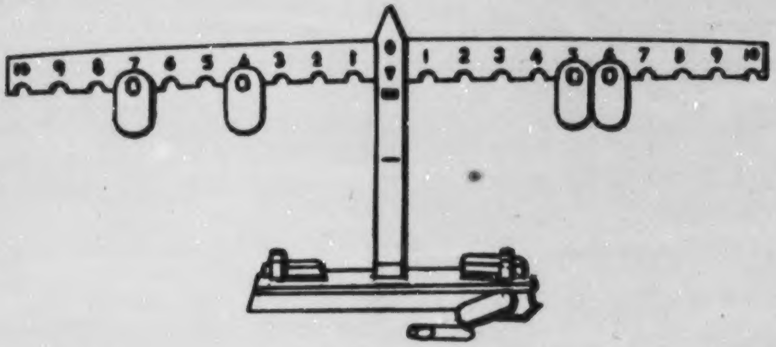
$$\begin{array}{c}\boxed{2}\\ \boxed{4}\\ \boxed{7}\end{array}$$

Sum is 13.

Arrange them in another way and find the sum. $\boxed{7}$ $\boxed{2}$ $\boxed{4}$ Sum is 13. Did the sum change? Why?

Discuss why the manner in which numbers are grouped does not affect the sum.

Experiment with a mathematical balance. Balance 11 in as many ways as you can. When the arms are in perfect balance, the mathematical sentence is true.



Record results in mathematical sentences.

$11 = 5 + 6$
$7 + 4 = 11$
$7 + 4 = 5 + 6$

Use such materials as activity cards with a math balance to provide for independent discoveries.

Write >, <, =, or ≠ in the □ to make the sentences true.

3 + 4 □ 2 + 5

7 + 6 □ 6 + 6

9 + 2 □ 7 + 8

Check your answers on the math balance.

Name the missing sums in the boxes:

+	5	3	9	0	4	6	1	2	7
6	11								
9					13				

Write your own addition tables.

Play: Guess My Rule

Teacher thinks of a rule, e.g., add 6. Children give □ numbers. Teacher gives △ numbers.

□	△
4	10
11	17
6	12

Discuss: the relationship between □ and △
the rule used to derive the △ number
the open sentence which fits all cases □ + 6 = △

**

UNIT 5. SUBTRACTION OF WHOLE NUMBERS

Reinforce basic facts, sums 18 or less. Include the following ideas:

a. addition and subtraction as related operations
b. subtraction as comparison - difference (missing addend):
   addend + $\square$ = sum
c. role of zero in subtraction

Suggestions For Pupil Activities

Use addition table in Unit 4 to locate missing addends.

$$4 + \square = 10$$

Give directions:

Locate 4 (addend) in the left column.
Move across the row to 10 (sum).
Name the number at the top of this column, 6 (missing addend).
Write 6 in the placeholder.

Locate other missing addends.

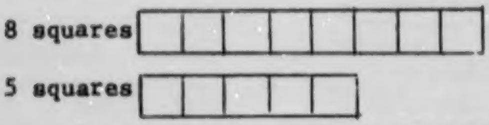
Discuss in each case the family $4 + 6 = \square$

$$4 + \square = 10$$

$$\square + 6 = 10$$

Write a subtraction equation to compare two numbers

- Match



- Remove the squares that match (5)
- The number of squares left is 3.
- The difference between 8 and 5 is 3.
- We write: $8 - 5 = 3$
- Discuss family: $5 + 3 = 8$; $3 + 5 = 8$; $8 - 5 = 3$; $8 - 3 = 5$

PLAY CODE GAMES

Move to right indicates add. Move to left indicates subtract. Use number line, if necessary. Complete the table.

START	MOVE	STOP	NUMBER SENTENCE
9	6 to right, $\overrightarrow{6}$	15	9 + 6 = 15
15	6 to left, $\overleftarrow{6}$	9	15 - 6 = 9
9	7 to right, $\overrightarrow{7}$	16	9 + 7 = 16
16	8 to left, $\overleftarrow{8}$	8	16 - 8 = 8
8	4 to right, $\overrightarrow{4}$	12	8 + 4 = 12

Generalize: Subtracting a number undoes adding that number.
Adding a number undoes subtracting that number.

Zero in subtraction

Explore patterns:

A.	6 - 2 = ☐	11 - 2 = ☐	24 - 2 = ☐
	6 - 1 = ☐	11 - 1 = ☐	24 - 1 = ☐
	6 - 0 = ☐	11 - 0 = ☐	24 - 0 = ☐

Discuss:
When zero is subtracted from a number the result is that number (identity element).

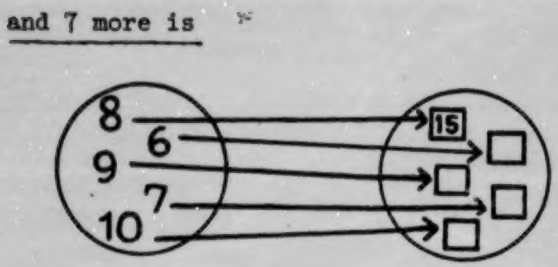
B.	6 - 4 = ☐	11 - 9 = ☐	18 - 16 = ☐
	6 - 5 = ☐	11 - 10 = ☐	18 - 17 = ☐
	6 - 6 = ☐	11 - 11 = ☐	18 - 18 = ☐

Observe then discuss:
When a number is subtracted from itself, the result is zero.

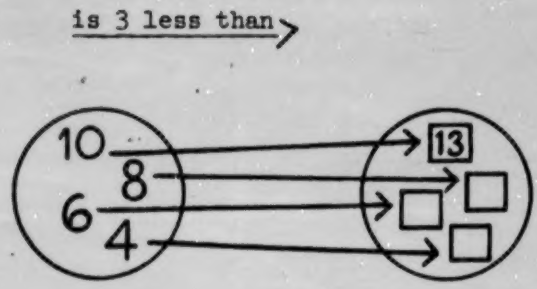
Use mapping activities to review and reinforce addition and subtraction skills.

Give directions as follows:

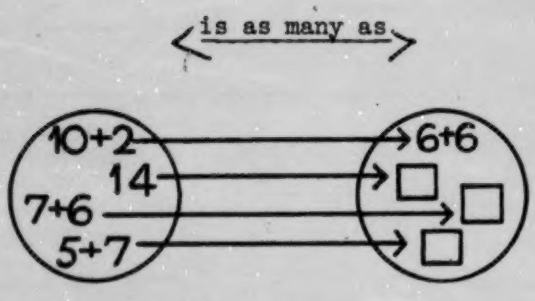
The arrow gives the "rule," you give the answer.

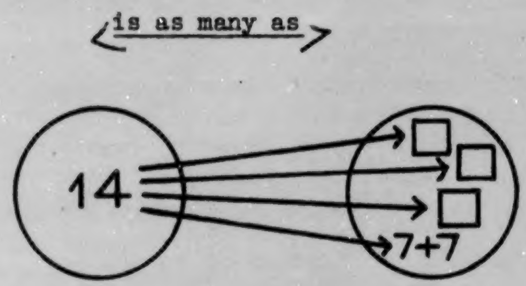


Each arrow from a number in the first circle tells you to add 7 to that number, e.g., 8 and 7 more are 15. Put the answer in the second circle.



Hint: 8 is 3 less than what number?





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UNIT 6. MEASUREMENT: TIME - CALENDAR

Using projects, develop concepts of time with respect to weeks and months. Record date as: month/day/year.

Suggestions for Pupil Activities

Use a calendar page. Locate these dates: the 1st, the 8th, the 15th. Name the day on which each of these dates falls. Discuss the interval of time between each date as a period of 1 week or 7 days.

Construct calendars for specified months of the year. Discuss the interval of time from the first day of the month through the last day of the month as a period of one month.

Use a calendar for the current year. Investigate the number of days in each month. Record data in chart form.

Month	Days
Jan.	31
Feb.	28 (or 29)
March	31

Does each month have the same number of days? Discuss the variation in the number of days in each month. Observe that each new month begins on the day after the preceding month ends. Try graphing the data.

Use the calendar to find: today's date, yesterday's date, tomorrow's date, next Monday's date. Record the dates in different ways: the 29th of October; October 29, 1978; 10/29/78.

Note: Reference to the calendar should be encouraged throughout the year.

**

UNIT 7. MULTIPLICATION OF WHOLE NUMBERS

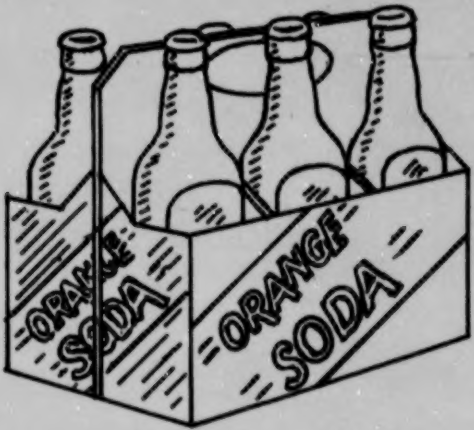
Using rectangular arrays, reinforce concept of multiplication. Develop basic multiplication facts: twos through 5 twos; threes through 5 threes. Record horizontally and vertically,

$$\text{e.g., } 5 \times 2 = \quad \begin{array}{r} 2 \\ \underline{\times\ 5} \end{array} \quad \begin{array}{r} 5 \\ \underline{\times\ 2} \end{array} \quad 2 \times 5 = \boxed{}$$

Observe and use the commutative property of multiplication, e.g., 5 x 2 = 2 x 5.

Suggestions for Pupil Activities

Form arrays using lima beans, bottle tops, paper clips, color cubes, pegboards, geoboards, paper discs, egg cartons, 6-pack holders, etc.



Discuss. The number of rows in the array (3).
The number of objects in each row (2).
The number of objects in the array (6).
Develop sentences related to the array.

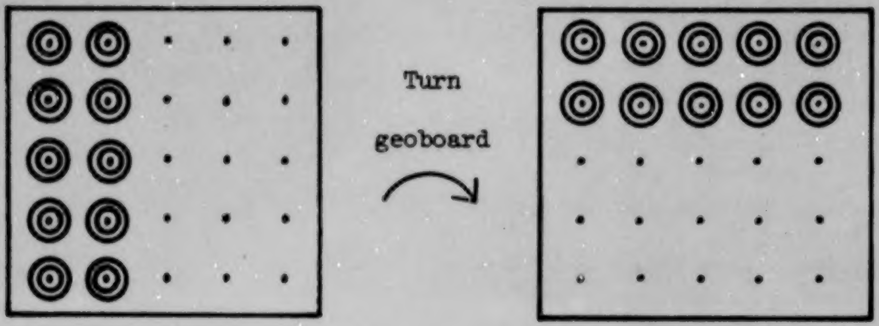
3 twos = 6

3 x 2 = 6

$$\begin{array}{r} 2 \\ \underline{\times\ 3} \\ 6 \end{array}$$

Form arrays for: 5 x 2, 2 x 3, 5 x 3. Try forming arrays for any number of threes or twos.

Use geoboard to demonstrate the commutative property of multiplication. Markers of the same shape and color can be placed over the nails.



Since   5 x 2 = 10   and   2 x 5 = 10

Then   5 x 2 = 2 x 5

In a similar way show that:

3 x 2 = 2 x 3   5 x 3 = 3 x 5

4 x 2 = 2 x 4   1 x 5 = 5 x 1

1 x 2 = 2 x 1   4 x 3 = 3 x 4

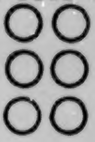
**

UNIT 8. DIVISION OF WHOLE NUMBERS

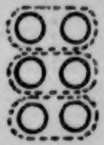
Reinforce concept of division by relating division to separating a set of objects into equivalent subsets. Develop basic division facts: twos in 4; in 6; in 8; in 10. Threes in 6; in 9; in 12; in 15. Record: $4 \div 2 = \square$ or $2\overline{)4}$. Develop understanding of multiplication and division as related operations.

Suggestions For Pupil Activities

A. Separate sets of objects into equivalent subsets.
Arrange six discs in three rows with the same number of discs in each row.



Discus: How many discs in all: (6)
Place a string around sets of two discs.



How many groups of two? (3)
How many twos in six? (3)

The question "How many twos in six?" may be recorded as:

$\square$ twos in 6 $\qquad$ $2\overline{)6}$

$\square \times 2 = 6$ $\qquad$ $6 \div 2 = \square$

The answer may be recorded inside the placeholder or above the six as shown:

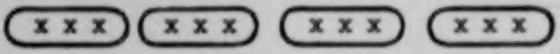
$$\begin{array}{r} 3 \\ 2\overline{)6} \end{array}$$

B. Find out: how many twos there are in 4; in 6; in 10.
how many threes there are in 6; in 12; in 15.

Record the answers in different ways.

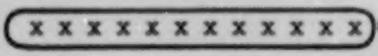
Use objects such as cubes, discs, buttons, interlocking cubes to:

a. form equivalent sets



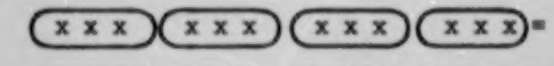
= 4 threes

b. join equivalent sets



$= 4 \times 3 = 12$

c. separate the set into subsets (subgroups) of three to find the number of threes in 12.



$= \square \times 3 = 12$

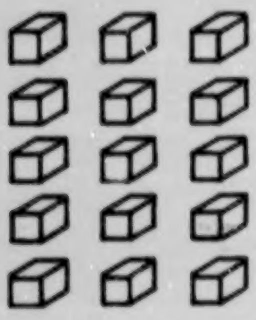
Develop related multiplication and division sentences for the experience.

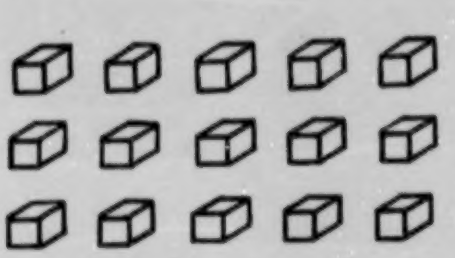
Since $4 \times 3 = 12$ then $\square \times 3 = 12$

Since $12 \div 3 = 4$ then $4 \times 3 = \square$

$4 \times 3 = 12$ so $\begin{array}{r}\square\\ 3\overline{)\,12}\end{array}$

Form and interpret arrays of objects in terms of multiplication and division.





$5 \times 3 = 15$ (multiplication)

$\square \times 3 = 15$ (division)

$3 \times 5 = 15$ (multiplication)

$\square \times 5 = 15$ (division)

Begin to observe multiplication - division families, e.g.,

$5 \times 3 = 15$

$\square \times 3 = 15$

$5 \times \square = 15$

$3 \times 5 = \square$

$15 \div 3 = \square$

$15 \div 5 = \square$

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UNIT 9. MEASUREMENT: TIME - CLOCK

Reinforce concept of hour and half hour. Develop concept of minute and number of minutes in an hour; telling time in quarter hours. Introduce term: minute marks - after the hour, before the hour.

Suggestions for Pupil Activities

Encourage children to develop individual logs indicating data such as:

Library at half past 10
Math lab at 11 o'clock
Lunch at 12 o'clock

Use a real clock or a clock with gears which synchronizes the movement of the hands to show the time at the beginning and/or at the end of each activity.

Set an alarm clock to ring one hour after 9 o'clock. Discuss the position of the minute hand and the hour hand. Record 9 o'clock. When the alarm rings, note the position of the hands on the clock. Record 10 o'clock.

Discuss: What time will it be 1 hour later?
Where will the hands be?

In a similar way review concept of half hour.

Use a stop watch or a clock with a second hand to encourage an appreciation of how "long" a minute is.

Investigate: How many multiples of 2 can you write in one minute?
How high can you count by ones in one minute?
How many times can you walk or skip around the room in one minute?

Provide individual model clocks with minute marks and develop telling time to the quarter hour.

a. Observe that there are 60 minute marks around the clockface by counting the number of marks between the numerals 12 and 1; between 1 and 2; between 2 and 3; between 12 and 3; etc.

b. Draw a line from 12 to 6 and a line from 3 to 9 so that the clockface shows 4 equal parts. Discuss each part as one fourth or one quarter of the whole clockface.

c. Count the number of minutes in each quarter hour; in a half hour or two fourths of an hour; in three fourths of an hour; in 1 hour.

d. Discuss the meaning of "a quarter after 2" as 15 minutes after 2 o'clock and record 2:15. What does the numeral to the left of the colon indicate? (the hour) What does the numeral to the right of the colon indicate? (the minutes after the hour).

Note: Activities involving the use of the clock should be emphasized throughout the year.

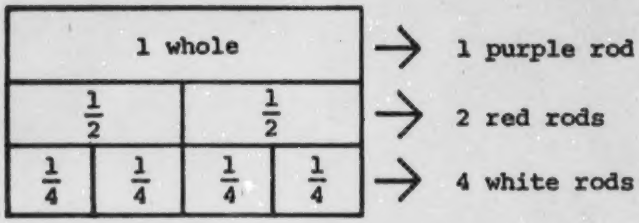
UNIT 10. OPERATIONS: FRACTIONAL NUMBERS

Using physical objects, recall concept of halves and fourths.
Reinforce and/or develop finding 1/2 and 1/4 of a number of things.

Suggestions For Pupil Activities

Use strips of paper, colored rods, pattern blocks and other similar materials to review halves and fourths of a single object.

Demonstrate relationships: halves to 1 whole
fourths to 1 whole
fourths to halves



Write mathematical sentences to describe the relationships.

$\frac{1}{2} < 1$ $\frac{1}{2} > \frac{1}{4}$

$\frac{1}{2} < \frac{3}{4}$ $\frac{2}{2} = 1$

$\frac{2}{4} = \frac{1}{2}$ $\frac{4}{4} = 1$

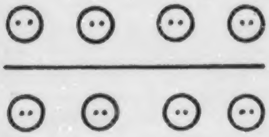
$\frac{1}{2}$ of $\frac{1}{2} = \frac{1}{4}$

Experiment with paper models of geometric shapes. Find ways of folding the shapes into halves; into fourths. Record the results in chart form.

Shape	Number of Ways for Halves	Number of Ways for Fourths
Circle ○	?	?
Rectangle ▭		
Square □		
Rhombus ◇		
Trapezoid ⏢		

Use bottle tops, buttons, lima beans, jacks, wrapped candy and other similar objects. Develop the concept of fractional parts of a number of things by:

a. Share between two children to find one half of a number of objects.



8 buttons

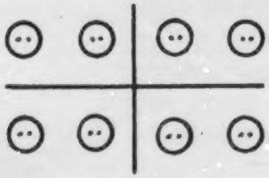
4 buttons for each child

each child has one half of the 8 buttons

4 is one half of 8

$\frac{1}{2}$ of 8 = 4

b. Share among 4 children to find one fourth of a number of objects.



8 buttons

2 buttons for each child

each child has one fourth of 8 buttons

2 is one fourth of 8

$\frac{1}{4}$ of 8 = 2

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UNIT 11. MEASUREMENT: WEIGHT

Using project experiences, reinforce meaning of pound and ounce. Develop fractional parts of a pound: $\frac{1}{2}$, $\frac{1}{4}$. Record: $\frac{1}{2}$ of 16 oz. = 8 oz. $\frac{1}{4}$ of 16 oz. = 4 oz.

Introduce Metric unit of weight: gram (g)

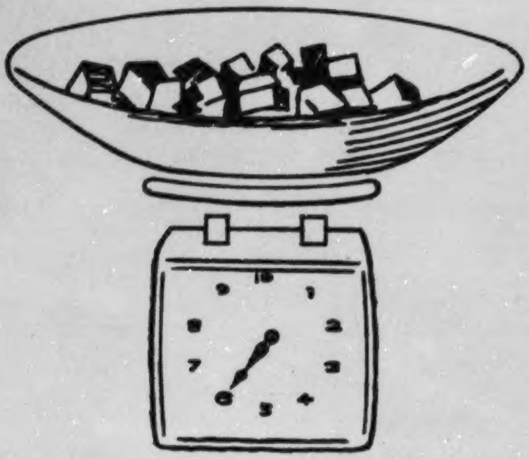
Suggestions For Pupil Activities

Hold a 1-ounce weight in each hand to get the feel of an ounce. Weigh several objects that you think might weigh about an ounce and see how close you are.

Find objects in the classroom that you think would weigh one or more ounces. Record your guess (estimate) and the actual weight on a chart and tell if your guess was over or under the actual weight.

Object	Guess	Weight	Were you over or under
Eraser			
Door Key			
Penny			
Ring			
Ruler			
5 paper clips			
Chalk			
Crayon			

Experiment with 1 oz. weights and dial scales.



Observe the movement of the hand on the dial as each weight is placed on the pan. Determine the number of weights placed on the scale when the hand points to the numeral 1. Check that 16 ounces weigh the same as 1 pound by using a balance scale to balance a 1 pound weight and sixteen - 1 ounce weights.

Conclude that these 16 ounces weigh the same as 1 pound.

Count the ounce marks between 0 and 1 and determine the half-way mark. Find out how many 1 ounce weights must be placed on the scale to reach this mark. Check by counting the number of marks.

Conclude that 8 ounces weigh the same as $\frac{1}{2}$ pound.

In a similar manner determine that 4 ounces = $\frac{1}{4}$ pound.

Make a list of objects that weigh approximately 1 lb. and/or $\frac{1}{2}$ lb. Check by weighing and develop a chart.

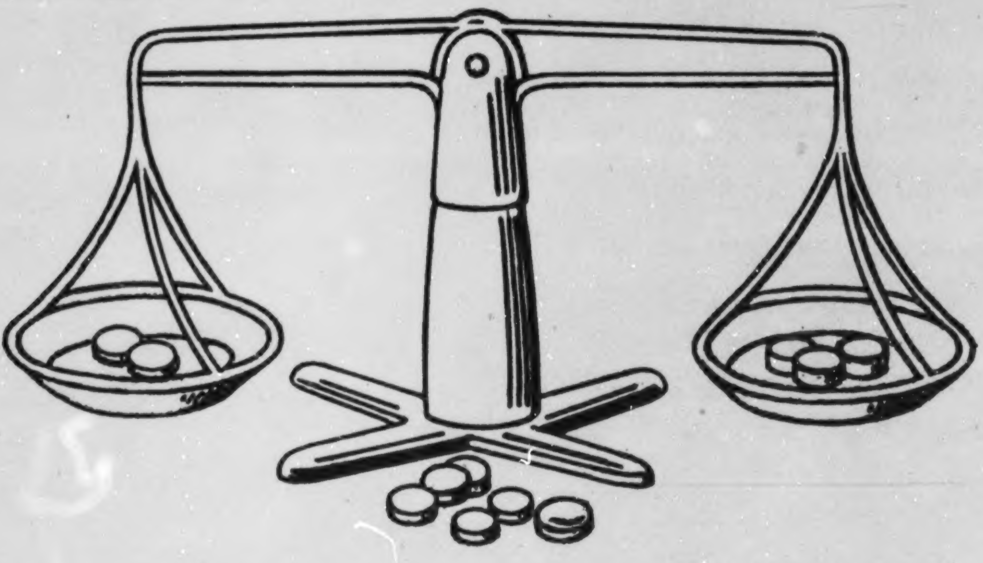
Object	Estimate	Weight
Mathematics book		
Block of wood		
Ruler		
Your shoe		

Questions like these may help:

- How many 1-ounce weights make a pound?
- How many ounces are there in 1/2 pound? in 1/4 pound?
- If there are 8 1-ounce weights on the scale, how many will have to be added to make a pound?
- If there are 8 1-ounce weights on the scale, how many do you remove to leave 1/4 pound?

Arrange a set of objects (rocks, toys, blocks, sea shells) from lightest to heaviest. Guess the weight of each object. Weigh each object and record the weight in ounces and in pounds. Compare the actual weight with the estimates.

Use a balance scale, 1-ounce weights and an assortment of beads, marbles or beans.



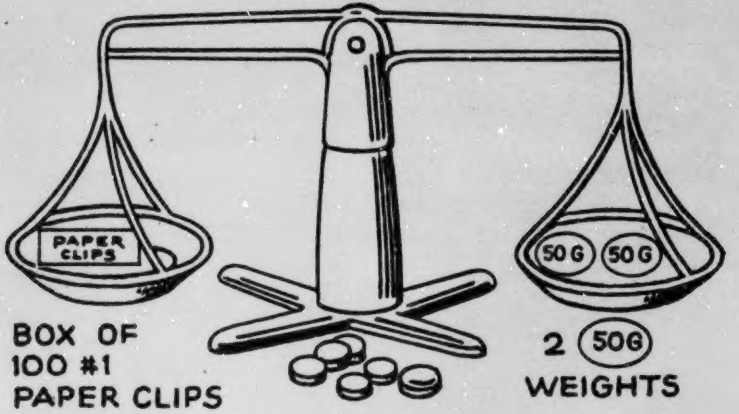
Find out how many beads will balance 1 oz., 2 oz., 3 oz., and so on. Make a table as shown.

How many in 1 oz.	2 oz.	3 oz.	4 oz.	5 oz.	8 oz.	1 lb.
Beads						
Beans						
Marbles						

Introducing Grams and Kilograms - Metric Units

The following activities are designed to guide you and the pupils. Experiences in measuring weight are given to introduce students to the concepts and to the common metric units of weight, the gram (g) and the kilogram (kg). At this time no attempt should be made to teach prefixes and to make conversions whether within the metric system or in relation to the United States units.

Use a balance scale or a kilogram dial scale and either plastic or iron gram weights (1 gram, 10 grams, 100 grams, 250 grams, etc.). Experiment to find out how many grams weigh 1 kilogram. Provide many experiences in weighing objects in grams and kilograms.



Use the plastic weights marked 5 grams, 10 grams, 20 grams, and the balance scale. Find out how many grams balance a nickel, a pen, a pencil, 5 paper clips, a small package of potato chips, a candy bar, a piece of gum, a small package of peanuts, a cookie, and other similar items. Record the weight of the items in grams.

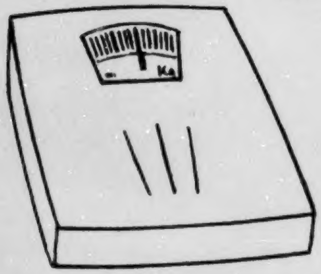
Find other objects in the classroom and guess whether they weigh a kilogram, more than a kilogram or less than a kilogram. Check your estimate by weighing. Show the results on a chart.

Object	Estimate (Guess)	Weight
Ruler	1 kilogram	less than a kilogram
Your shoe		
Block of wood		
Scissors		
Box of crayons		
Math book		
Dictionary		
Stapler		

If a personal scale is available, have students weigh themselves and record their weights in kilograms (kg).

A graph can be made showing the weights of the different pupils in the class. Pupils make observations and comparisons. (the heaviest, the lightest; do most boys weigh more than most girls, etc.).

Go on a shopping trip to a supermarket. Look for the weight of boxed and canned foods that may be given in grams. Make a list or draw pictures of things found in the store where the weight is given in grams.



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UNIT 12. NUMERATION

Use materials such as squared materials, abacus, multibase arithmetic blocks to:

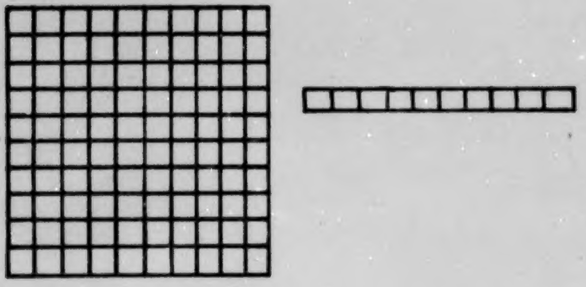
a. count by hundreds and tens to 10 hundreds

b. group by hundreds, tens, and ones and record using expanded notation, e.g., 1 hundred + 2 tens + 3 ones
100 + 20 + 3 = 123

Suggestions For Pupil Activities

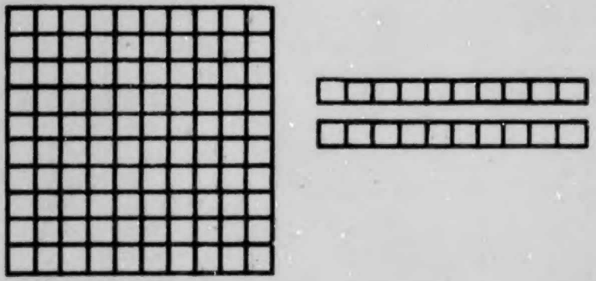
Organize number sequences to demonstrate counting by tens to 190.

Hundreds Tens



one hundred ten

110

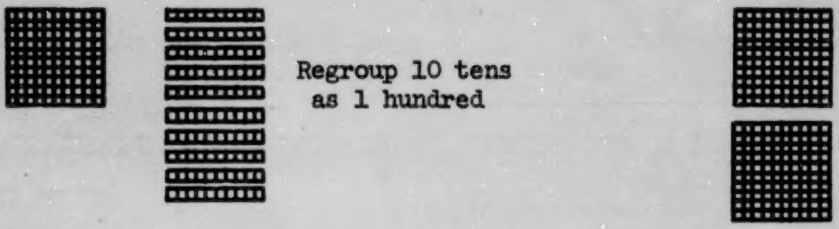


one hundred twenty

120

Similarly, show 130, 140, 150, ...190.

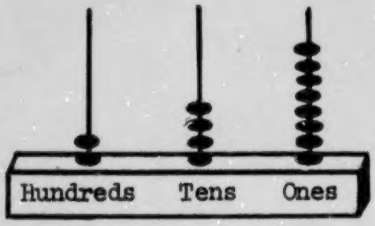
Demonstrate counting by tens from 190 to 200.



1 hundred 10 tens = 2 hundreds
200

Discuss: counting pattern - each succeeding number is 10 greater than the preceding number
standard numeral for one hundred ten, one hundred twenty, etc.
regrouping 10 tens as one hundred when going from:
190 to 200
290 to 300
390 to 400 etc.

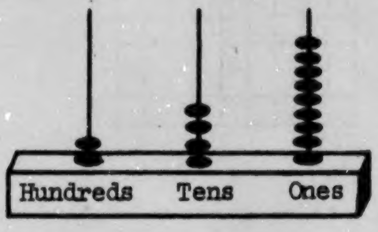
Use an abacus or a counting frame to demonstrate a variety of counting sequences involving hundreds, tens and ones. Name the numbers using expanded and standard numerals.



2 hundreds + 4 tens + 8 ones

200 + 40 + 8

248



2 hundreds + 4 tens + 9 ones

200 + 40 + 9

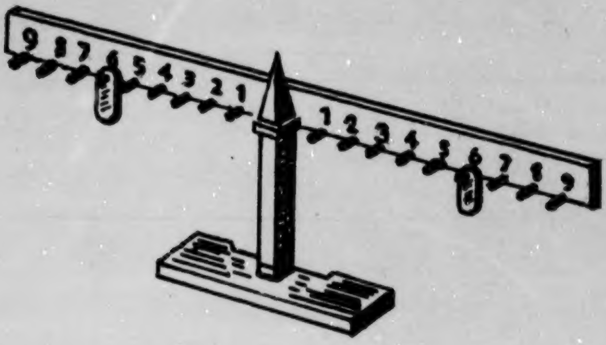
249

Use a mathematical balance to compare numbers. Label the unmarked discs on each arm of the balance with number sequences such as:

10, 20, 30 ...100

100, 200, 300 ...1000

50, 100, 150 ...500



Make the following sets of sentences true.

80 ☐ 30 + 50

30 ☐ 60

30 > ☐

30 < ☐

400 ☐ 200

400 ☐ 700

400 > ☐

400 < ☐

250 > ☐

350 > ☐

300 ☐ 450

500 ☐ 450

Provide practice in reading and writing three-place numerals.

Make as many different numerals as you can from the first one using the same three digits:

143 341 431 ______________________

235 ____________ 352 ____________

483 ______________________ 834 ___

List the following numbers in order from the least to greatest.

341, 143, 431, 413 ____ ____ ____ ____

532, 352, 253, 523 ____ ____ ____ ____

259, 261, 254, 306 ____ ____ ____ ____

List the following numbers in order from greatest to least.

190, 300, 280, 170 ____ ____ ____ ____

248, 450, 259, 295 ____ ____ ____ ____

**

UNIT 13. ADDITION OF WHOLE NUMBERS

Reinforce and/or develop addition of numbers named by two-digit numerals without and with regrouping in the ones place.

Suggestions For Pupil Activities

Explore ways of computing sums with no regrouping. Use squared material, multibase blocks, dimes and pennies, colored rods, and other place value materials to demonstrate the following forms.

Expanded Form

$$\begin{array}{r} 62 \\ +\ 7 \\ \hline \end{array} \qquad \begin{array}{rcl} 60 + & 2 & \\ + & 7 & \\ \hline 60 + & 9 & = 69 \end{array}$$

Expanded Form

$$\begin{array}{r} 82 \\ +17 \\ \hline \end{array} \qquad \begin{array}{rcl} 80 + & 2 & \\ + 10 + & 7 & \\ \hline 90 + & 9 & = 99 \end{array}$$

Standard Form

$$\begin{array}{r} 62 \\ +\ 17 \\ \hline 79 \end{array}$$

Add the ones (2 ones + 7 ones =)
Record the 9
Add the tens (6 tens + one ten =)
Record the 7

Explore ways of computing sums with regrouping in the ones place. Use place value materials to demonstrate each method.

Method 1

$$\begin{array}{r} 45 \\ +\ 8 \\ \hline \end{array} \qquad \begin{array}{l} 4 \text{ tens} + 5 \text{ ones} \\ \qquad\qquad\ \ 8 \text{ ones} \\ \hline 4 \text{ tens} + 13 \text{ ones} = 5 \text{ tens} + 3 \text{ ones} = 53 \end{array}$$

Note: 13 ones = 1 ten + 3 ones

$$\begin{aligned} \text{so } 4 \text{ tens} + 13 \text{ ones} &= 4 \text{ tens} + (1 \text{ ten} + 3 \text{ ones}) \\ &= (4 \text{ tens} + 1 \text{ ten}) + 3 \text{ ones} \\ &= 5 \text{ tens} + 3 \text{ ones} \end{aligned}$$

Method 2

$$\begin{array}{r} 45 \\ +\ 8 \\ \hline \end{array} \qquad \begin{array}{l} 40 + 5 \\ + \qquad 8 \\ \hline 40 + 13 = 50 + 3 = 53 \end{array}$$

Method 3

$$\begin{array}{r} 45 \\ +\ 8 \\ \hline \end{array} \qquad \begin{array}{rl} 45 & \\ +\ 8 & \\ \hline 13 & \text{(add ones)} \\ 40 & \text{(add tens)} \\ \hline 53 & \end{array} \qquad \begin{array}{rl} 45 & \\ +\ 8 & \\ \hline 40 & (40 + 0) \\ 13 & (5 + 8) \\ \hline 53 & \end{array}$$

Method 4 (Standard Form)

$$\begin{array}{r} 45 \\ +\ 8 \\ \hline 53 \end{array}$$

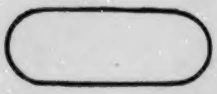
Add the ones
13 ones are 1 ten + 3 ones
Record the 3 below the bar (and remember the 1 ten)
Add the tens (4 tens and 1 ten)
Record the 5

Provide opportunities to compute sums using more than one method. Use additions such as:

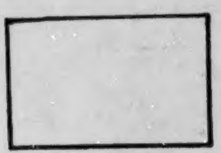
$$\begin{array}{r} 67 \\ +\ 8 \\ \hline \end{array} \qquad \begin{array}{r} 73 \\ +\ 9 \\ \hline \end{array} \qquad \begin{array}{r} 27 \\ +\ 14 \\ \hline \end{array} \qquad \begin{array}{r} 68 \\ +\ 26 \\ \hline \end{array}$$

Summarize the steps in computing the sum of 67 + 25 using a flow chart.

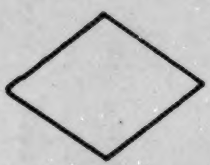
Optional: Some flow chart symbols and their meanings are:



Start or Stop

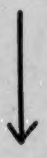


Operation

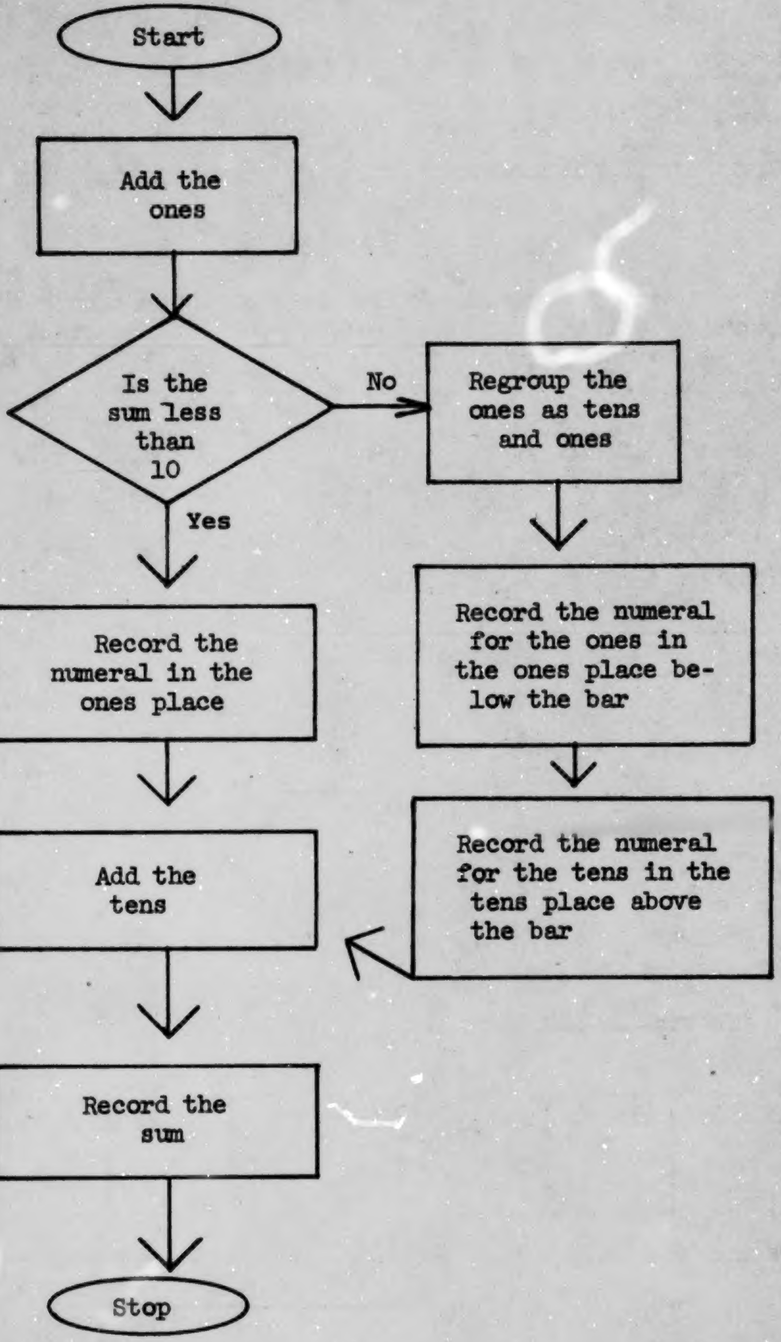


Question Box

(Answer Yes
or No)



Direction


Start
Add the ones
Is the sum less than 10
No
Yes
Regroup the ones as tens and ones
Record the numeral for the ones in the ones place below the bar
Record the numeral for the tens in the tens place above the bar
Record the numeral in the ones place
Add the tens
Record the sum
Stop

**

UNIT 14. SUBTRACTION OF WHOLE NUMBERS

Reinforce and/or develop subtracting tens and ones, with regrouping.

Suggestions For Pupil Activities

Explore ways of computing differences without regrouping. Use squared material, multibase blocks, dimes and pennies, colored rods, and other place value materials, if needed, to demonstrate the following forms.

Expanded Form

$$\begin{array}{r} 69 \\ \underline{-\ \ 7} \end{array} \qquad \begin{array}{r} 60 + 9 \\ \underline{-\qquad 7} \\ 60 + 2 = 62 \end{array}$$

Expanded Form

$$\begin{array}{r} 87 \\ \underline{-\ 25} \end{array} \qquad \begin{array}{r} 80 + 7 \\ \underline{-(20 + 5)} \\ 60 + 2 = 62 \end{array}$$

Standard Form

$$\begin{array}{r} 75 \\ \underline{-23} \\ 52 \end{array}$$

Subtract the ones (5 - 3 = ?)
Record the 2
Subtract the tens
(7 tens - 2 tens = ?)
Record the 5

Explore ways of computing differences where it is necessary to regroup tens for ones.

a. Practice renaming numbers. Use place value materials if needed.

Tens	Ones
5	3

Regroup 1 ten for 10 ones

Tens	Ones
4	13

5 tens + 3 ones = 53

50 + 3 = 53

4 tens + 13 ones = 53

40 + 13 = 53

Verify that 40 + 13 names the same number as 50 + 3.

Use physical materials, such as pennies and dimes and squared material, as needed.

b. Use place value materials to demonstrate each method of computing differences.

Method 1

$$\begin{array}{r} 53 \\ \underline{-\ 28} \end{array} \qquad \begin{array}{l} 5 \text{ tens } 3 \text{ ones} \\ -\ 2 \text{ tens } 8 \text{ ones} \end{array} \qquad \begin{array}{l} \quad 4 \text{ tens} + 13 \text{ ones} \\ \underline{-\ 2 \text{ tens} \qquad 8 \text{ ones}} \\ \quad 2 \text{ tens} + \ \ 5 \text{ ones} = 25 \end{array}$$

Method 2

$$\begin{array}{r} 53 \\ \underline{-\ 28} \end{array} \qquad \begin{array}{r} 50 + 3 \\ \underline{-(20 + 8)} \end{array} \qquad \begin{array}{r} 40 + 13 \\ \underline{-(20 + \ \ 8)} \\ 20 + \ \ 5 \end{array} = 25$$

Method 3 (Standard Form)

$$\begin{array}{r} 53 \\ \underline{-\ 28} \end{array}$$

Rename 53 as 40+ 13
Subtract the ones
Record the 5
Subtract the tens
Record the 2

Provide opportunities to compute differences using more than one method. Use subtractions such as:

$$\begin{array}{r} 37 \\ \underline{-\ 9} \end{array} \qquad \begin{array}{r} 73 \\ \underline{-\ 8} \end{array} \qquad \begin{array}{r} 46 \\ \underline{-17} \end{array} \qquad \begin{array}{r} 52 \\ \underline{-26} \end{array}$$

Construct and use a flow chart to summarize the steps in computing differences. See Unit 13 for a suggested procedure.

**

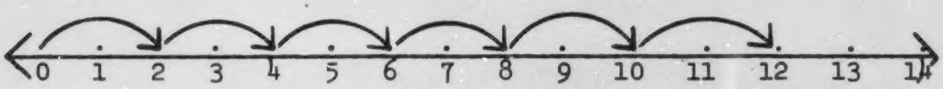
UNIT 15. MULTIPLICATION OF WHOLE NUMBERS

Reinforce facts for twos through 5 twos; threes through 5 threes. Develop facts for twos through 9 twos; threes through 9 threes. Record horizontally and vertically. Observe and use the commutative property of multiplication.

Suggestions for Pupil Activities

Adapt learning activities in Unit 7. (arrays)

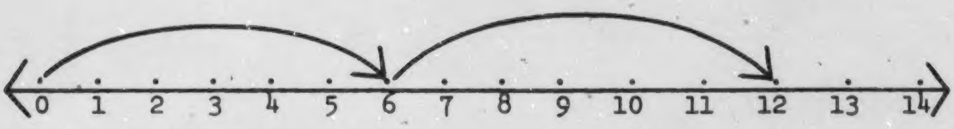
Make use of number lines to illustrate multiplication.



6 jumps of 2 = □

6 x 2 = □

$$\begin{array}{r} 2 \\ \times 6 \\ \hline \end{array}$$



2 jumps of 6 = □

2 x 6 = □

$$\begin{array}{r} 6 \\ \times 2 \\ \hline \end{array}$$

**

UNIT 16. DIVISION OF WHOLE NUMBERS

Reinforce facts for twos through the number of twos in 10; for threes through the number of threes in 15. Develop facts for twos in 12; in 14; in 16; in 18; for threes in 18; in 21; in 24; in 27.

Record $2\overline{)12}$ $12 \div 2 = \square$

Suggestions for Pupil Activities

Adapt learning activities in Unit 8 (arrays, separating objects into equivalent sets).

Additional Suggestions

Construct and complete tables.

Children	Gloves
1	2
2	4
3	6
	8
	10

etc.

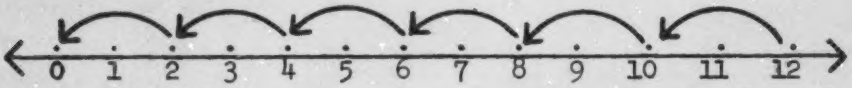
Discuss: There are two gloves for each child.
If there are 8 gloves, how many children are there?
How many 2's in 8?

$$\square \times 2 = 8$$

$$2\overline{)8}$$

$$8 \div 2 = \square$$

Make use of number lines to illustrate division.



Start at o. Jump forward by 2's. How many jumps to reach 12?
How many 2's in 12? ☐ x 2 = 12 12 ÷ 2 = 6

Start at 12. Jump back from 12 by 2's. How many jumps to reach zero? How many 2's in 12? ☐ x 2 = 12. 12 ÷ 2 = ☐

$2\overline{)12}$

Similarly, show twos in 14, 16, and 18. Also, threes in 18, 21, 24, and 27.

****

UNIT 17. PROBLEM SOLVING

Develop problem-solving skills. Reinforce basic addition, subtraction, multiplication and division facts through a problem-solving approach.

Suggestions For Pupil Activities

Write word problems using numerical information contained in the charts and graphs developed in Units 2, 4, 5, 14, 15, and 16.

a. Record problem:

A tricycle has 3 wheels.
How many wheels do four tricycles have?

b. Discuss the number sentences that could be used to solve the problem.

c. Translate the problem into open sentences.

3 + 3 + 3 + 3 =

4 x 3 =

d. Complete the open sentences. Discuss the solution (12) as the answer to the question in the verbal problem.

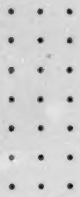
e. Have students prepare tables to help solve verbal problems.

Tricycle	1	2	3	4	5	6	7
Wheels	3	6					

Discuss: How many wheels on one tricycle?
How many wheels on two tricycles?
Make up your own questions.

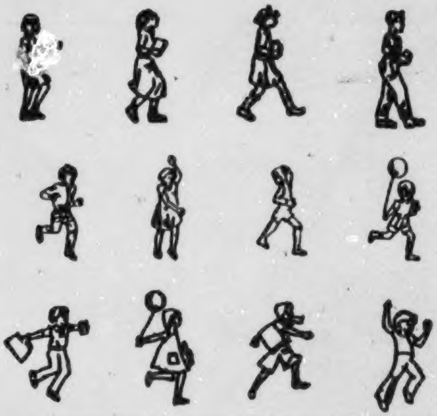
Use arrays to help solve word problems that involve multiplication and division. For example, the third grade Glee Club is going to have a picnic. There are seven children in the club. Each child will receive three pieces of fried chicken. How many pieces of fried chicken should be bought?

3 pieces of chicken each



$7 \times 3 = \square$

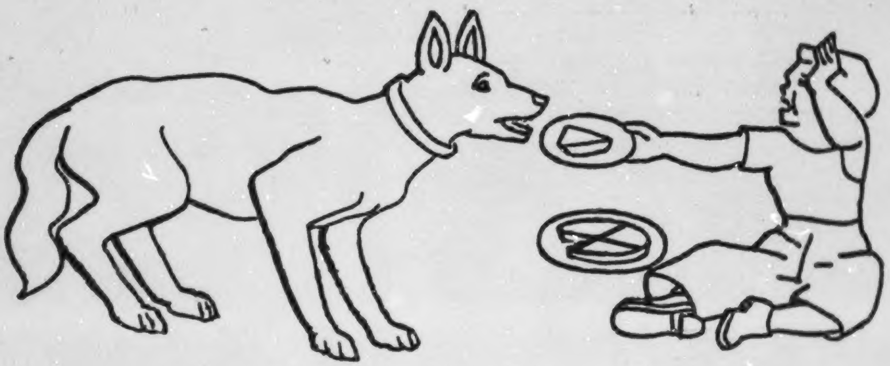
12 children went on the trip to the zoo. The teacher wanted them to walk in groups of four. How many groups of four did she form?



Draw pictures of the problem or use physical models to demonstrate problem-solving strategies.

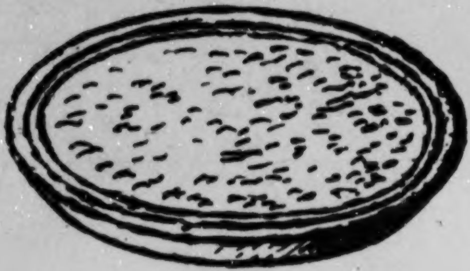
Problem:

Randy's mother cut his bologna and cheese sandwich into 4 equal parts. Randy gave 1 part to his dog and ate the other 3. What portion of the sandwich did Randy eat?



Problem

Three children had a whole pizza for lunch. If Myra took 1/4 of the pizza and Eddie took 2/4, how much was left for Luis?



$$\frac{1}{4} + \frac{2}{4} + \boxed{} = 1$$

Discuss the missing addend.

Using a flow chart, summarize the steps in solving a word problem. (See page 36.)

Problem:

9 children from class 2-201 eat lunch in school. 7 children from class 2-202 eat lunch in school. Only 3 children from class 2-203 eat lunch in school. How many children from the 3 classes eat lunch in school?

Discuss, dramatize, role play, and write word problems related to open sentences such as:

$6 + 9 = \square$

$\square + 9 = 15$

$6 + \square = 15$

$15 - 9 = \square$

$15 - \square = 9$

$3 + 8 + 5 = \square$

$9 \times \square = 27$

$12 \quad 2 = \square$

$\frac{1}{4} + \frac{1}{2} = \square$

Write and solve word problems derived from newspaper ads, catalogues and classroom activities.

PRODUCE

RED - RIPE

WATERMELON

BY THE PIECE 7c LB.

1 pound of watermelon=7¢

$\square$ pounds for 35¢

Note: Problem-solving involves reading comprehension. Therefore, it is extremely important that the teacher continue to provide problem-solving opportunities throughout the year on all concepts covered. The problems presented in this bulletin are samples and cannot provide the necessary practice. Consult textbooks or newspapers or any other available source for problems on all concepts covered. Strengthen reading by "reading in mathematics" such as the above.

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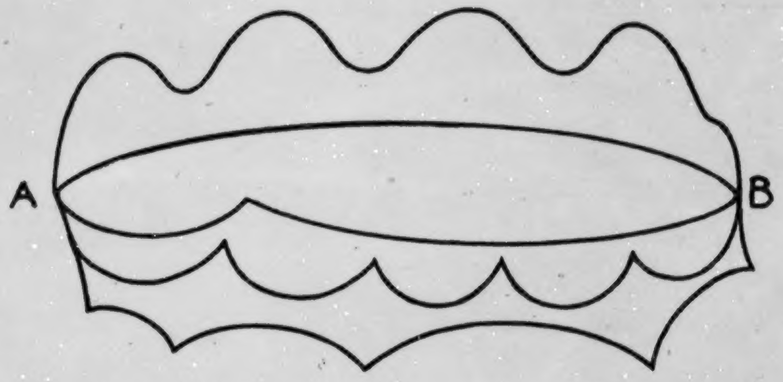
UNIT 18. GEOMETRY

Develop and/or reinforce:

ideas of: open, closed, simple, not simple
concepts of: point, line segment, line, ray

Suggestions For Pupil Activities

Develop the idea of curve as a path going from one point to another by demonstrating various ways of joining two points on the chalkboard, floor, piece of acetate and other similar materials. Note: A curve can be wavy (〰) or straight (____). Here are 5 curves joining points A and B.



Use colored pieces of yarn to represent different paths between two locations when you walk:

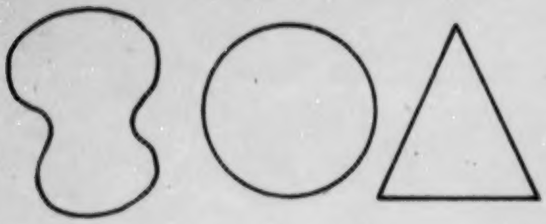
from your desk to the door of the classroom
from the wastepaper basket to the chalkboard
from the math table to the closet.

Identify the paths that are straight and those that are not. Compare the different paths between two specified locations with respect to length. Discuss the idea that the shortest path is a straight path.

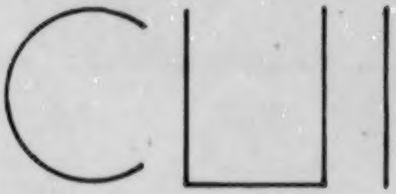
Use yarn, pipe cleaners, string, chalkboard, geoboards and similar materials to form models of simple closed curves.

A

CLOSED

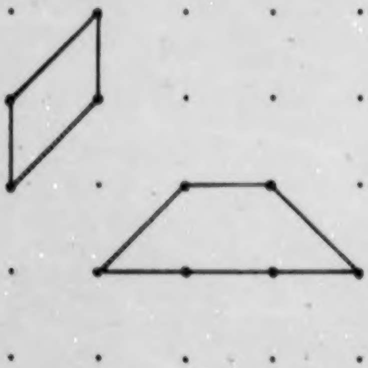


NOT CLOSED

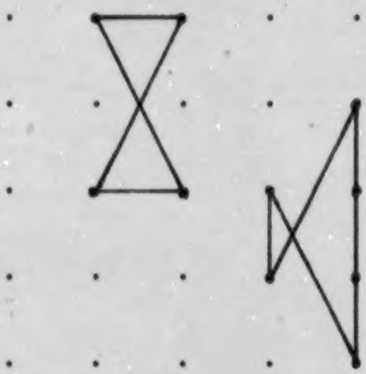


B

Some geoboard uses:



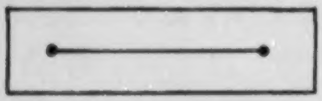
Simple Closed Curves



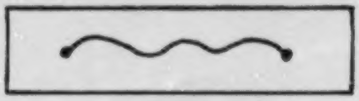
Not Simple Closed Curves

Discuss how you can tell whether a curve is simple or not. Find models of simple closed curves in the classroom. Remember: Any curve that does not cross itself is called a simple closed curve.

Use pictures and/or diagrams to provide an intuitive introduction to the geometric concept of line segment.



Line segment



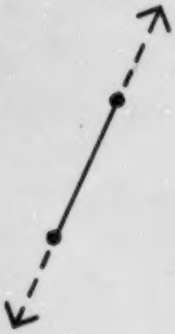
Not a line segment

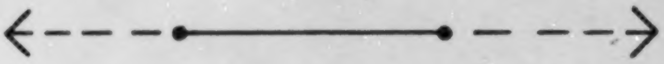
Discuss: What is the same? Both have two endpoints.
What is different? One is straight.

Use ruler, straightedge, geoboard and different color rubberbands and other similar materials to form representations of line segments of various lengths. Measure the line segments. Record the results on a chart.

Line Segment	Length
Red	2 inches
Yellow	4 inches
Green	6 inches

Use pictures or draw models of line segments. Derive a model of a line by extending the line segment in both directions.

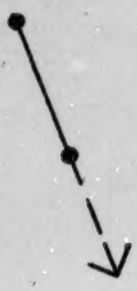


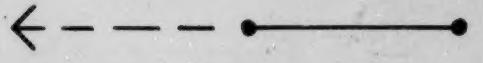


Compare model of a line with a line segment and make observations such as:

a line extends infinitely in either direction.
a line segment is part of a line.
a line segment has two endpoints.
arrows are used to indicate that there is no end to a line.

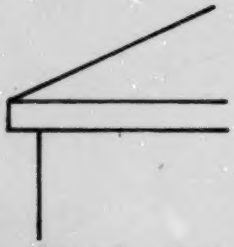
Using another diagram of a line segment derive a model of a ray by extending the line segment in one direction.



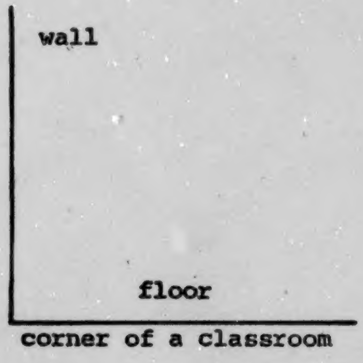


Compare the model of a ray with a line and with a line segment.

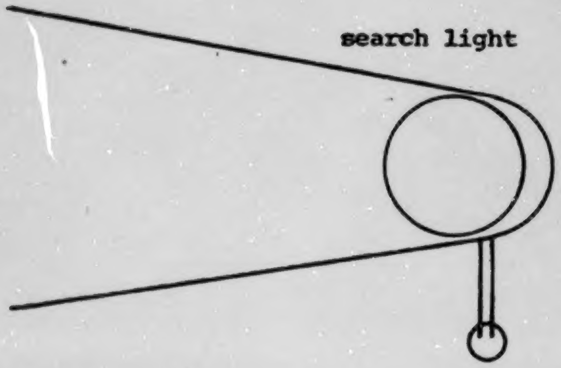
Make lists of objects in the classroom, home, and community which suggest points, line segments, and rays.

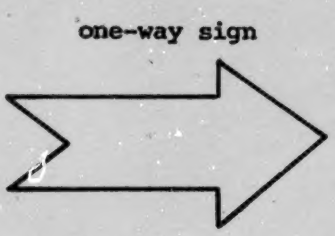


edge of a desk



corner of a classroom





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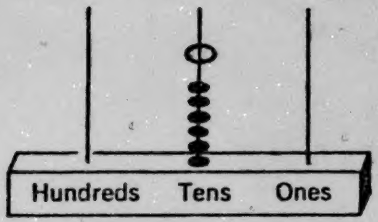
UNIT 19. ADDITION OF WHOLE NUMBERS

Develop adding ten and multiples of ten to numbers through 99, sums in hundreds.

Suggestions For Pupil Activities

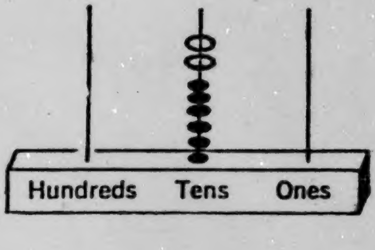
Explore patterns using squared material, graph paper, abacus, interlocking cubes, colored rods, mathematical balance, etc.

60 + 10 = 70



6 tens + 1 ten = 7 tens

60 + 20 = ☐



6 tens + 2 tens = 8 tens

60 + 40 = ☐

Discuss exchanging 10 tens for 1 hundred. Continue. Demonstrate on abacus the regrouping of 10 tens as 1 hundred.

60 + 50 = ☐

60 + 60 = ☐

etc.

68

In a similar manner demonstrate the following series.

66 + 10 =	66 + 40 =
66 + 20 =	66 + 50 =
66 + 30 =	66 + 60 =

etc.

Explore ways of computing sums with regrouping in the tens place. Use place value materials to demonstrate each method.

Method 1

$$\begin{array}{r} 66 \\ \underline{+\ 70} \end{array} \qquad \begin{array}{r} 6 \text{ tens} + 6 \text{ ones} \\ \underline{+\ 7 \text{ tens} + 0 \text{ ones}} \\ 13 \text{ tens} + 6 \text{ ones} \end{array} \begin{array}{l} \\ \\ = 1 \text{ hundred} + 3 \text{ tens} + 6 \text{ ones} \\ = 136 \end{array}$$

Method 2

$$\begin{array}{r} 66 \\ \underline{+\ 70} \end{array} \qquad \begin{array}{r} 60 + 6 \\ \underline{+\ 70 + 0} \\ 130 + 6 \end{array} \begin{array}{l} \\ \\ = 136 \end{array}$$

Method 3

$$\begin{array}{r} 66 \\ \underline{+\ 70} \\ \\ \\ \\ \end{array} \qquad \begin{array}{rl} 66 & \\ \underline{+\ 70} & \\ 6 & (6 + 0) \\ \underline{130} & (60 + 70) \\ 136 & \end{array} \qquad \begin{array}{rl} 66 & \\ \underline{+\ 70} & \\ 130 & (60 + 70) \\ \underline{6} & (6 + 0) \\ 136 & \end{array}$$

Method 4 Standard Form

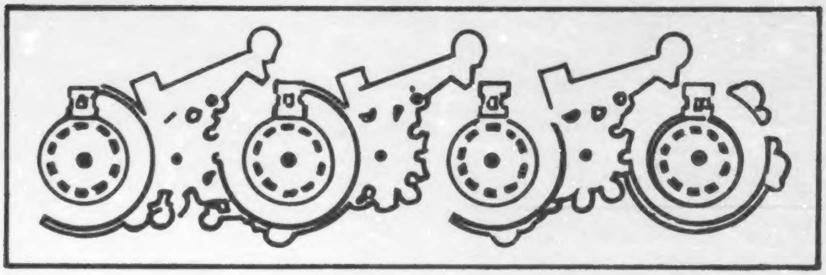
$$\begin{array}{r} 66 \\ \underline{+\ 70} \\ \end{array} \qquad \begin{array}{r} 66 \\ \underline{+\ 70} \\ 136 \end{array}$$

Add the ones
Record the 6
Add the tens
13 tens may be regrouped as 1 hundred + 1 ten
Record 13 placing the digit 3 in the tens place and the digit 1 in the hundreds place

---

Provide opportunities to compute sums using calculators. Use additions such as:

28	34	76	99
+ 80	+ 90	+ 60	+ 30



Discuss how the calculators compute the sums. Compare with paper and pencil methods.

*

UNIT 20. NUMERATION

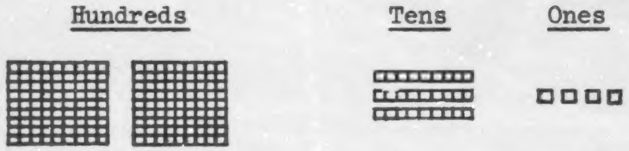
Provide additional experiences with counting and place value through 999.

Suggestions For Pupil Activities

Adapt learning activities in Unit 12, which used materials such as squared materials, abacus and mathematical balances.

Additional Suggestions

Use place value materials to represent numbers through 999. Fill in place value chart.

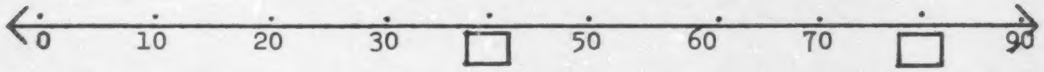


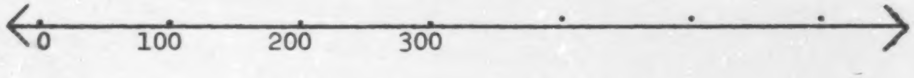
Hundreds	Tens	Ones
2	3	4

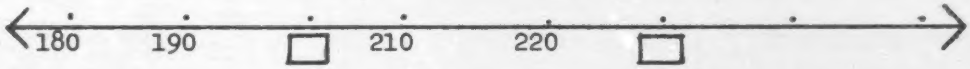
Name the number using expanded and standard forms.

200 + 30 + 4 = 234

Count by tens and by hundreds on number lines.







Complete number sequences. Discuss the pattern.

110, 120, 130 ____, ____, ____, ____

460, 470, ____, ____, 500, ____, ____

570, 580, 590, ____, ____, ____

270, 260, ____, ____, ____

430, 420, 410, ____, ____, ____

Write the numeral for the number word.

four hundred twenty-eight __________

three hundred forty-five __________

ninety-six __________

seven hundred twenty-one __________

nine hundred six __________

**

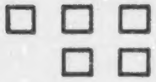
UNIT 21. ADDITION AND SUBTRACTION OF WHOLE NUMBERS

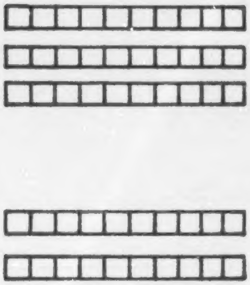
Develop adding multiples of a hundred, through 900. Use horizontal and vertical forms.

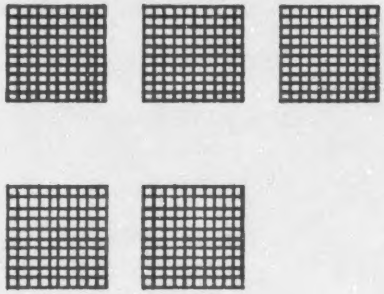
Develop subtracting multiples of a hundred, through 900.

Suggestions For Pupil Activities

Work with the abacus, bundles of sticks, squared materials, graph paper, multibase arithmetic blocks, interlocking cubes or other place value materials. Demonstrate the parallel between adding ones and adding multiples of ten; between adding multiples of ten and adding multiples of a hundred.







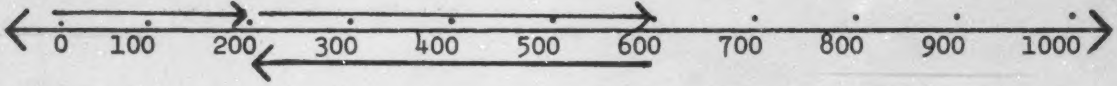
3 ones + 2 ones = 5 ones 3 + 2 = 5	3 tens + 2 tens = 5 tens 30 + 20 = 50	3 h + 2 h = 5 h 300 + 200 = 500
Adding Ones	Adding Multiples of Ten	Adding Multiples of 100
3 + 2 5	30 + 20 50	300 + 200 500

Through the use of place value materials demonstrate the parallel between subtracting ones and subtracting multiples of ten; between subtracting multiples of ten and subtracting multiples of a hundred.

Discuss the idea that subtracting multiples of a hundred is the same as subtracting multiples of ten and subtracting ones.

$$\begin{array}{r} 6 \\ -\ 2 \\ \hline 4 \end{array} \qquad \begin{array}{r} 60 \\ -\ 20 \\ \hline 40 \end{array} \qquad \begin{array}{r} 600 \\ -\ 200 \\ \hline 400 \end{array}$$

Illustrate the inverse operations on number lines.



Discuss the related addition and subtraction sentences.

$$200 + 400 = 600$$
$$600 - 400 = 200$$

Experiment with a mathematical balance. Label the discs on each arm of the balance with 100, 200, 300, ...1000. Replace each $\square$ and $\triangle$ with a correct numeral to make true sentences.

a. $500 = \square + \triangle$

b. $100 + \square + \triangle = 1000$

c. $400 + \square = 600$

etc.

Discuss other possible equations that can be derived on a math balance which is calibrated in multiples of 100 through 1000.

**

UNIT 22. ADDITION AND SUBTRACTION OF WHOLE NUMBERS

Develop adding numbers less than 1000 without regrouping.
Develop subtracting numbers less than 1000 without regrouping.

Suggestions For Pupil Activities

Explore ways of computing sums with no regrouping. Use squared materials, multibase blocks, abacus, or other place value materials.

For: $\begin{array}{r} 234 \\ +\ 42 \\ \hline \end{array}$

Place Value Chart Form

	H	T	O
	2	3	4
+		4	2
	2	7	6

Expanded Form

$$\begin{array}{rrrrrr} & 200 & + & 30 & + & 4 \\ + & & & 40 & + & 2 \\ \hline & 200 & + & 70 & + & 6 = 276 \end{array}$$

Partial Sums

$$\begin{array}{rl} 234 & \\ +\ 42 & \\ \hline 6 & (4 + 2) \\ 70 & (30 + 40) \\ +200 & (200) \\ \hline 276 & \end{array}$$

Standard Form

$$\begin{array}{r} 234 \\ +\ 42 \\ \hline 276 \end{array}$$

Add the ones
Record the 6 (the numeral for the ones)
Add the tens
Record the 7 (the numeral for the tens)
Add the hundreds
Record the 2 (the numeral for the hundreds)

Use the forms suggested in this unit to compute sums such as:

$$\begin{array}{r} 352 \\ +\ 246 \\ \hline \end{array} \qquad \begin{array}{r} 124 \\ +\ 203 \\ \hline \end{array} \qquad \begin{array}{r} 124 \\ 233 \\ +\ 342 \\ \hline \end{array} \qquad \begin{array}{r} 531 \\ 26 \\ +\ 110 \\ \hline \end{array}$$

Explore ways of computing differences with no regrouping. Use squared materials, multibase blocks, abacus, or other place value materials.

For: $\begin{array}{r} 548 \\ -\ 16 \\ \hline \end{array}$

Place Value Chart Form

$$\begin{array}{rccc} & H & T & O \\ \hline & 5 & 4 & 8 \\ - & & 1 & 6 \\ \hline & 5 & 3 & 2 \end{array}$$

Expanded Form

$$\begin{array}{rl} & 500 + 40 + 8 \\ - & \qquad\;\; 10 + 6 \\ \hline & 500 + 30 + 2 = 532 \end{array}$$

Partial Differences

$$\begin{array}{rrl} & 548 & \\ - & 16 & \\ \hline & 2 & (8 - 6) \\ & 30 & (40 - 10) \\ & 500 & (500) \\ \hline & 532 & \end{array}$$

Standard Form

$$\begin{array}{rr} & 548 \\ - & 16 \\ \hline & 532 \end{array}$$

Subtract the ones
Record the 2 (the numeral for the ones)
Subtract the tens
Record the 3 (the numeral for the tens)
Subtract the hundreds
Record the 5 (the numeral for the hundreds)

Use the forms suggested in this unit to compute differences such as:

$$\begin{array}{r} 647 \\ -\,123 \\ \hline \end{array} \qquad \begin{array}{r} 849 \\ -\,406 \\ \hline \end{array} \qquad \begin{array}{r} 963 \\ -\,320 \\ \hline \end{array}$$

If desk calculators are available, investigate how subtraction is performed on the machines. Try computing differences with a calculator.

Compute the combined registers of the 3rd grade and the 4th grade. Which grade has the greater number of pupils? How many more? Use appropriate numbers.

**

UNIT 23. ADDITION AND SUBTRACTION OF WHOLE NUMBERS

Develop addition of numbers less than 1000 with regrouping ones for tens.

Develop subtraction of numbers less than 1000 with regrouping tens for ones.

Suggestions For Pupil Activities

Explore ways of computing sums with regrouping in the ones place. Use place value materials.

Expanded Form

$$\begin{array}{r} 165 \\ \underline{+\ 29} \end{array} \qquad \begin{array}{l} 100 + 60 + 5 \\ \underline{+ \qquad 20 + 9} \\ 100 + 80 + 14 = 100 + 90 + 4 \\ \qquad\qquad\qquad\ = 194 \end{array}$$

Partial Sums

$$\begin{array}{rl} \underline{\text{HTO}} & \\ 165 & \\ \underline{+\ 29} & \\ 14 & (5 + 9) \\ 80 & (60 + 20) \\ \underline{100} & (100) \\ 194 & \end{array}$$

Standard Form

$$\begin{array}{r} 165 \\ \underline{+\ 29} \\ 194 \end{array}$$

Add the ones
14 ones may be regrouped as 1 ten + 4 ones
Record the 4 in the ones place and the 1 in the tens place
Add the tens
Record the 9 in the tens place
Add the hundreds
Record the 1 in the hundreds place

Use the forms suggested in this unit to compute sums such as:

$$\begin{array}{r} 453 \\ \underline{+\ 218} \end{array} \quad \begin{array}{r} 749 \\ \underline{+\ 207} \end{array} \quad \begin{array}{r} 324 \\ 105 \\ \underline{+\ 463} \end{array} \quad \begin{array}{r} 243 \\ 21 \\ \underline{+\ 317} \end{array}$$

Explore ways of computing differences.

a. Before computing differences with exchange (regrouping), practice renaming numbers named by three-digit numerals. Demonstrate regrouping (exchanging) tens for ones. Squared materials or multibase arithmetic blocks are useful here. Record the number representations in various ways.

$$235 = \begin{array}{|c|c|c|}\multicolumn{1}{c}{\text{Hundreds}} & \multicolumn{1}{c}{\text{Tens}} & \multicolumn{1}{c}{\text{Ones}} \\ \hline 2 & 3 & 5 \\ \hline \end{array} \xrightarrow{\text{Regroup 1 ten as 10 ones}} \begin{array}{|c|c|c|}\multicolumn{1}{c}{\text{Hundreds}} & \multicolumn{1}{c}{\text{Tens}} & \multicolumn{1}{c}{\text{Ones}} \\ \hline 2 & 2 & 15 \\ \hline \end{array}$$

$$235 = 2 \text{ hundreds} + 3 \text{ tens} + 5 \text{ ones} \xrightarrow[\text{Regroup 1 ten as 10 ones}]{} 2 \text{ hundreds} + 2 \text{ tens} + \square \text{ ones}$$

$$235 = \quad 200 + 30 + 5 \xrightarrow[\text{Regroup 1 ten as 10 ones}]{} 200 + 20 + \square$$

Verify that 200 + 20 + 15 names the same number as 200 + 30 + 5, that is 200 + 20 + 15 = 235 and 200 + 30 + 5 = 235.

b. Explore ways of computing differences where regrouping tens for ones is needed. Use place value materials as models of the various steps in computing.

$$\text{For: } \begin{array}{r} 263 \\ -\ 27 \\ \hline \end{array}$$

Place Value Chart Form

H	T	O
2	6	3
	2	7

Determine that it is necessary to regroup tens as ones

H	T	O
2	5	13
	2	7
2	3	6

Expanded Form

$$\begin{array}{r} 200 + 60 + 3 \\ -\qquad 20 + 7 \\ \hline \end{array}$$

Determine that it is necessary to regroup 1 ten for 10 ones

$$\begin{array}{r} 200 + 50 + 13 \\ -\qquad 20 + \ \ 7 \\ \hline 200 + 30 + \ \ 6 \end{array} = 236$$

Standard Form

$$\begin{array}{r} 2\overset{5}{\cancel{6}}\overset{13}{\cancel{3}} \\ -\ \ 27 \\ \hline 236 \end{array}$$

Determine that it is necessary to regroup 6 tens as 5 tens + 10 ones
Subtract the ones (13 - 7)
Record the 6 in the ones place
Subtract the tens (50 - 20)
Record the 3 in the tens place
Subtract the hundreds
Record the 2 in the hundreds place

Use the forms suggested in this unit to compute differences such as:

$$\begin{array}{r}452\\ \underline{-\ 216}\end{array}\qquad\begin{array}{r}871\\ \underline{-\ 205}\end{array}\qquad\begin{array}{r}230\\ \underline{-\ 115}\end{array}$$

TEACHER'S NOTES

**

UNIT 24. ADDITION OF WHOLE NUMBERS

Develop adding numbers less than 1000 with regrouping tens for hundreds.

Suggestions For Pupil Activities

a. Practice adding multiples of ten less than 1000. See Units 19 and 21.

b. Explore ways of computing sums with regrouping in the tens place. Use place value materials as models of the various steps in computing.

$$\text{For: } \begin{array}{r} 184 \\ +\ 52 \\ \hline \end{array}$$

Place Value Chart Form

H	T	O
1	8	4
	5	2
1	13	6

→ Regroup 13 tens as 1 hundred + 3 tens →

H	T	O
1	8	4
	5	2
2	3	6

Expanded Form

$$\begin{array}{r} 100 + 80 + 4 \\ +\qquad 50 + 2 \\ \hline 100 + 130 + 6 \end{array} \begin{array}{l} = 200 + 30 + 6 \\ = 236 \end{array}$$

Partial Sums

H	T	O	
1	8	4	
	5	2	
		6	(4 + 2)
1	3	0	(80 + 50)
1	0	0	(100)
2	3	6	

Standard Form

$$\begin{array}{r} 184 \\ +\ 52 \\ \hline 236 \end{array}$$

Add the ones
Record the 6 in the ones place
Add the tens
13 tens may be regrouped as
   1 hundred + 3 tens
Record the 3 in the tens place
   and the 1 in the hundreds place
Add the hundreds
Record the 2 in the hundreds place

Use the forms suggested in this unit to compute sums such as:

$$\begin{array}{r} 362 \\ +\ \underline{274} \end{array} \qquad \begin{array}{r} 290 \\ +\ \underline{654} \end{array} \qquad \begin{array}{r} 293 \\ 112 \\ +\ \underline{434} \end{array}$$

TEACHER'S NOTES

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UNIT 25. SUBTRACTION OF WHOLE NUMBERS

Develop subtracting numbers less than 1000 with regrouping hundreds for tens.

Suggestions for Pupil Activities

a. Practice renaming numbers named by 3-digit numerals. Demonstrate exchanging (regrouping) hundreds for tens. Place value materials are useful here. Record the number representations in various ways.

$$346 = \begin{array}{|c|c|c|}\hline \text{Hundreds} & \text{Tens} & \text{Ones} \\ \hline 3 & 4 & 6 \\ \hline \end{array} \xrightarrow{\text{Regroup 1 hundred as 10 tens}} \begin{array}{|c|c|c|}\hline \text{Hundreds} & \text{Tens} & \text{Ones} \\ \hline 2 & 14 & 6 \\ \hline \end{array}$$

$$346 = 3 \text{ hundreds} + 4 \text{ tens} + 6 \text{ ones} \xrightarrow{\text{Regroup 1 hundred as 10 tens}} 2 \text{ hundreds} + 14 \text{ tens} + 6 \text{ ones}$$

$$346 = 300 + 40 + 6 \xrightarrow{\text{Regroup 1 hundred as 10 tens}} 200 + 140 + 6$$

Verify that 300 + 40 + 6 and 200 + 140 + 6 name the same number, that is, 346.

b. Explore ways of computing differences where it is necessary to regroup 1 hundred for 10 tens. Use place value materials as models of the various steps in computing.

For: $\begin{array}{r} 346 \\ -\underline{172} \end{array}$

Place Value Chart Form

$$\begin{array}{r|c|l} \text{H} & \text{T} & \text{O} \\ \hline 3 & 4 & 6 \\ -\,1 & 7 & 2 \\ \hline & & \end{array}$$

Determine that it is necessary to regroup hundreds as tens.

$$\begin{array}{r|c|l} \text{H} & \text{T} & \text{O} \\ \hline 2 & 14 & 6 \\ -\,1 & 7 & 2 \\ \hline & & \end{array}$$

Place Value Form

$$\begin{array}{rl} & 3 \text{ hundreds} + 4 \text{ tens} + 6 \text{ ones} \\ - & \underline{1 \text{ hundred} + 7 \text{ tens} + 2 \text{ ones}} \end{array}$$

Determine that it is necessary to regroup hundreds as tens

$$\begin{array}{rl} & 2 \text{ hundreds} + 14 \text{ tens} + 6 \text{ ones} \\ - & \underline{1 \text{ hundred} + 7 \text{ tens} + 2 \text{ ones}} \\ & 1 \text{ hundred} + 7 \text{ tens} + 4 \text{ ones} \\ & \qquad\qquad 174 \end{array}$$

Expanded Form

$$\begin{array}{r} 300 + 40 + 6 \\ -(100 + 70 + 2) \\ \hline \end{array}$$

Determine that it is necessary to regroup hundreds as tens

$$\begin{array}{r} 200 + 140 + 6 \\ -\ (100 + \ \ 70 + 2) \\ \hline 100 + \ \ 70 + 4 \end{array} = 174$$

Standard Form

$$\begin{array}{r} \overset{2}{\cancel{3}}\ \overset{14}{\cancel{4}}\ 6 \\ -\ 1\ 7\ 2 \\ \hline 1\ 7\ 4 \end{array}$$

Subtract the ones
Record the 4 in the ones place
Are there enough tens to subtract 7 tens?
Determine that it is necessary to regroup 1 hundred as 10 tens, thus changing 4 tens to 14 tens and 3 hundreds to 2 hundreds
Subtract the tens
Record the 7 in the tens place
Subtract the hundreds
Record the 1 in the hundreds place

Use the forms suggested in this unit to compute differences such as:

$$\begin{array}{r} 523 \\ -\ 260 \\ \hline \end{array} \qquad \begin{array}{r} 706 \\ -\ 143 \\ \hline \end{array} \qquad \begin{array}{r} 265 \\ -\ \ 82 \\ \hline \end{array} \qquad \begin{array}{r} 820 \\ -\ 230 \\ \hline \end{array}$$

***

UNIT 26. MEASUREMENT. TIME: CLOCK

Use projects involving experiences to develop understanding of telling time in 5-minute intervals. Apply understanding of A.M. and P.M.

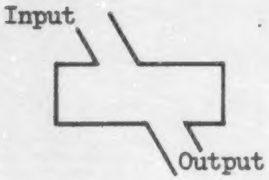
Suggestions for Pupil Activities

Involve groups of children in keeping a record of the number of cars that pass the school in 5-minute intervals.

TIME A.M.	CARS									
9:00 - 9:05	✓	✓	✓	✓	✓	✓				
9:05 - 9:10	✓	✓	✓							
9:10 - 9:15	✓	✓								
9:15 - 9:20	✓	✓	✓	✓	✓	✓	✓			
9:20 - 9:25	✓	✓	✓	✓	✓					
9:25 - 9:30	✓	✓	✓	✓						

Discuss: In which 5-minute interval did the greatest number of cars pass? the least number of cars pass? What other questions can be answered by the chart?

Use the idea of a time machine to solve problems involving time. Complete the chart. Tell the rule (adding 5-minute intervals).



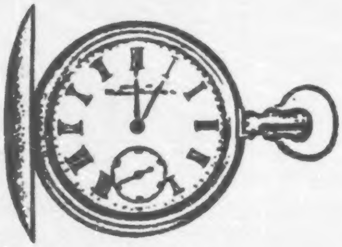
Input	Output
10:05	10:10
8:35	8:40
3:00	
9:50	
4:55	

The function or rule may be changed to: subtract 5-minute intervals; plus 1 hour; subtract 1 hour; plus 1 half hour; minus 1 half hour, etc.

Collect TV schedules and time tables. Match the written notation with the hands on a clock.

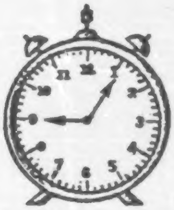
Practice reading and recording time using a variety of clocks.

Roman Numerals



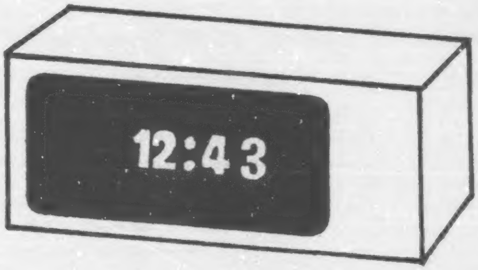
1 o'clock or 1:00

Arabic Numerals



5 minutes after 9

Digital Clock



43 minutes after 12

Construct a graph to show the events of your school day. Discuss how much time was spent on the various activities of the day, e.g., reading, mathematics, art, science. Find time differences in the activities, e.g., how long is it between art period and lunch?

Note: See Unit 2 for procedures on constructing a graph.

Keep a record of how you spent a day.

Name ______________________ Date ____________

How I Spent My Day

What I Did	Time
Woke up	7:00
Got dressed	7:45
Ate breakfast	8:00
Went to school	8:30
etc.	etc.

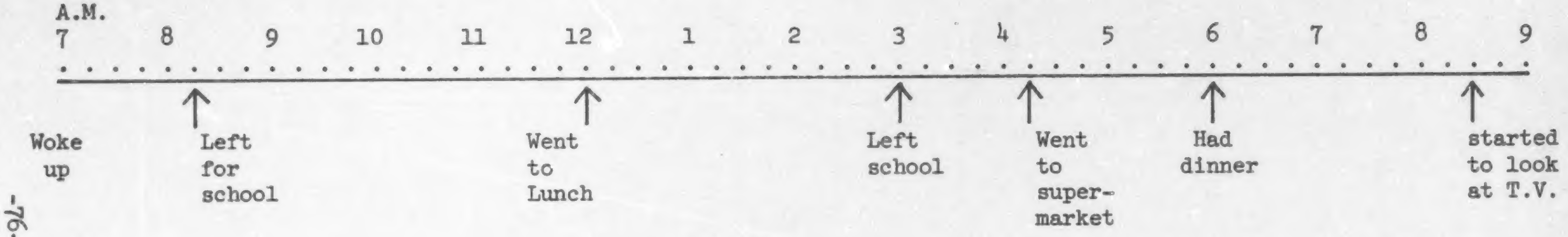
Compare and discuss the individual charts.

Present the concepts of A.M. and P.M. by establishing the fact that there are 24 hours in a day. A clock face shows only 12 hours so the hour hand goes around twice in one day. There are 12 hours between 7 o'clock in the morning and 7 o'clock in the evening. When it is 7 o'clock before 12 noon the time is record as 7:00 A.M. When it is 7 o'clock after 12 noon the time is recorded as 7:00 P.M.

Indicate A.M. or P.M. for each time shown on the charts.

Read and interpret time lines.

Mary's Day



a. Fill in the rest of the hours on the time line.
b. Show where P.M. begins.
c. How many hours are shown on the time line?
d. Is that more than or less than 1/2 day?
e. What time did Mary leave for school?
f. What time did she go to lunch?
g. Did she go to the supermarket in the morning?
h. Do you think that Mary gets enough sleep?
i. Make a time line of your day.

**

UNIT 27. MULTIPLICATION OF WHOLE NUMBERS

Reinforce facts for twos; for threes. Develop facts for fours through 5 fours; for fives through 5 fives. Observe and use the commutative property of multiplcation.

Using the distributive property of multiplication over addition, extend multiplication beyond 9 twos; e.g.,

$$10 \times 2 = (9 \times 2) + (1 \times 2) = 18 + 2 = 20$$

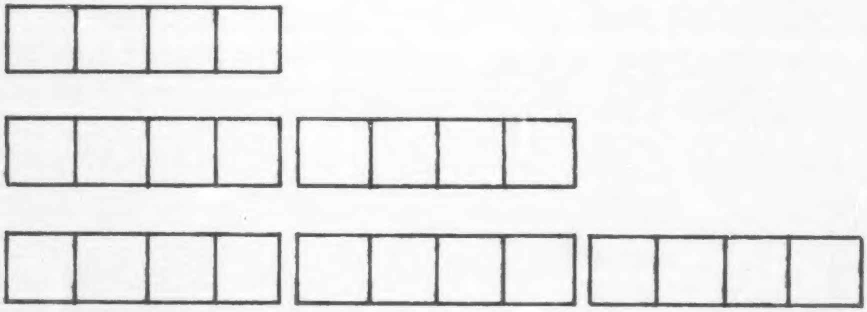
$$13 \times 2 = (10 + 3) \times 2 = (10 \times 2) + (3 \times 2) = 20 + 6 = 26$$

Suggestions for Pupil Activities

Adapt learning activities in Units 7 and 15 to develop fours through 5 fours; fives through 5 fives.

Additional Suggestions

Use interlocking cubes, scored tagboard strips (squared materials), colored rods, multibase arithmetic blocks and other similar materials to "build" multiplication facts.



5 x 4 = 20

Record the multiplications in vertical form.

$$\begin{array}{r}4\\ \times 1\\ \hline 4\end{array}\qquad\begin{array}{r}4\\ \times 2\\ \hline 8\end{array}\qquad\begin{array}{r}4\\ \times 3\\ \hline 12\end{array}\qquad\begin{array}{r}4\\ \times 4\\ \hline 16\end{array}\qquad\begin{array}{r}4\\ \times 5\\ \hline 20\end{array}$$

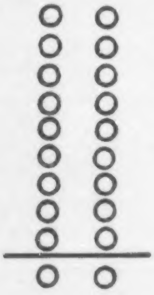
Discuss the pattern in the products as they are read from left to right.

Summarize multiplication facts for twos, threes, fours, and fives by constructing multiplication tables.

x	1	2	3	4	5
1	(1 x 1) 1			(1 x 4) 4	
2			(2 x 3) 6		
3	(3 x 1) 3			(3 x 4) 12	
4			(4 x 3) 12		
5				(5 x 4) 20	

With a different color chalk or crayon shade the boxes with products that equal 12. Record the two factors (numbers multiplied) for each product and discuss why the products are the same. Emphasize the use of the commutative property of multiplication in learning the basic multiplication facts on the chart.

Demonstrate using the distributive property of multiplication over addition to find the product of 10 x 2, 11 x 2, 12 x 2, etc. Use objects such as cubes, discs, bottle tops, beads on a frame or other similar materials, to build rectangular arrays.



9 twos = 18 9 x 2 = 18

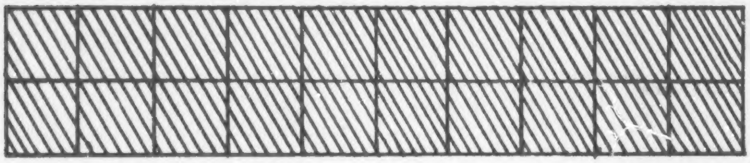
$$\begin{array}{r}1\text{ two} = 2\\ \hline 10\text{ twos} = 20\end{array}\qquad\qquad\begin{array}{r}1 \times 2 = 2\\ \hline 10 \times 2 = 20\end{array}$$

Write multiplication sentences for:

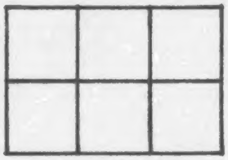
a.	Number of twos above the line	9 x 2 = 18
b.	Number of twos below the line	1 x 2 = 2
c.	Number of twos in all	10 x 2 = 20

Shade or color 2 arrays of squares on centimeter graph paper to represent the products of multiplications such as: 2 x 11, 2 x 12, 2 x 13. Write a multiplication sentence that describes each array.

For: 2 x 13 =



2 x 10 = 20



2 x 3 = 6

Combine the partial products and name the final product: 20 + 6 = 26

How many squares shaded? (2 x 10 or 20)
How many squares not shaded? (2 x 3 or 6)
How many squares together? (2 x 13 or 26)
Is the product the same as 20 + 6?

The description of the arrays may be shown in equation form.

$$
\begin{aligned}
2 \times 13 &= (2 \times 10) + (2 \times 3) \\
&= 20 \quad\quad + \quad 6 \\
&= 26 \\
2 \times 13 &= 26
\end{aligned}
$$

**

UNIT 28. DIVISION OF WHOLE NUMBERS

Reinforce facts for twos; for threes. Develop facts for fours in 8; in 12; in 16; in 20; for fives in 10; in 15; in 20; in 25.

Suggestions for Pupil Activities

Adapt learning activities in Units 8 and 16.

Additional Suggestions

Write numerals on a chart.

1	2	③	4	5	⑥	7	8	⑨	10
11	⑫	13	14	⑮	16	17	⑱	19	20
㉑	22	23	24	25	26	27	28	29	30

Count by threes and put a circle around each multiple of 3.

Discuss: How many threes in 6?
How many threes in 18? etc.

Formulate divison notations that relate to the questions asked.
For example:

$6 \div 3 =$ $\quad$ $3\overline{)\,6}$ $\quad$ $\square \times 3 = 18$

Use the multiplication table developed in Unit 27 to find the missing factor in sentences such as: $3 \times \square = 12$.

Give directions: Locate the 3 (known factor) in the column on the left.
Move across the row to 12 (the product).
Name the number at the top of this column.
4 is the missing factor.
Write 4 in the placeholder.
Locate other missing factors.

*

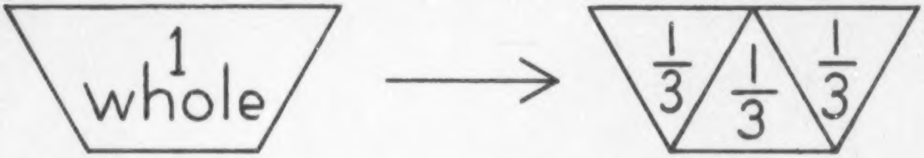
UNIT 29. NUMBER: FRACTIONAL NUMBERS

Reinforce concept of third of a whole.

Develop: concept of sixth of a whole
understanding of equivalence: thirds, sixths
meaning of terms numerator, denominator

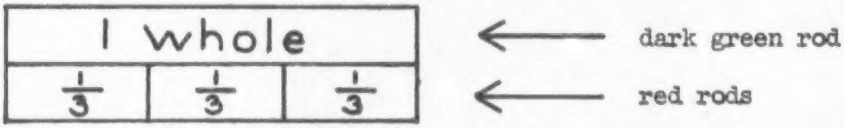
Suggestions for Pupil Activities

Use rectangular and circular paper shapes, colored rods, candy bars, pattern blocks, number lines or rays, and other similar materials. Show thirds: Name each part $\frac{1}{3}$.

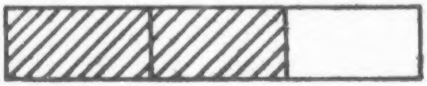


Initiate a discussion which will include ideas such as:

- three triangles cover one trapezoid
- the three parts are the same size
- one triangle is one-third of the trapezoid
- there are three thirds in one whole
- one third is one of the three parts
- $\frac{1}{3}$ is the numeral for each part



Each red rod is one third of the dark green rod.



$\frac{\text{2 parts shaded}}{\text{3 parts in all}} \rightarrow \frac{2}{3}$

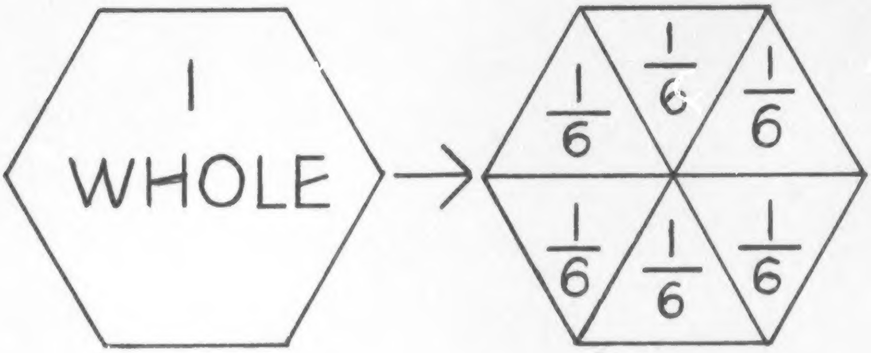
two of the parts would be $\frac{1}{3} + \frac{1}{3}$ or $\frac{2}{3}$

Write mathematical sentences to describe relationships.

$\frac{1}{3} < 1$ $\frac{2}{3} > \frac{1}{3}$ $\frac{3}{3} = 1$

$\frac{1}{3} + \frac{1}{3} = \frac{2}{3}$ $\frac{3}{3} - \frac{1}{3} = \frac{2}{3}$ $\frac{1}{3} + \frac{1}{3} + \frac{1}{3} = \frac{3}{3}$

Introduce sixth of regions and name each part of $\frac{1}{6}$.



What part of the hexagon is a triangle?

Discuss: there are 6 sixths in one whole
the six parts are the same size
one sixth is one of the six parts
$\frac{1}{6}$ is the numeral for each part

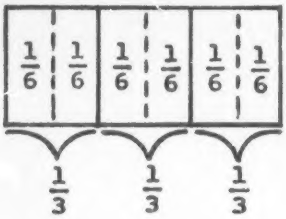
the meaning of the numeral, $\frac{1}{6}$.

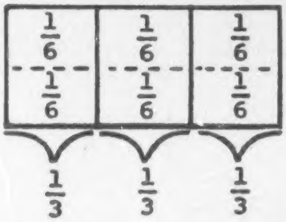
Write mathematical sentences to describe relationships.

$\frac{1}{6} < 1$ $\frac{1}{6} < \frac{2}{6}$ $\frac{6}{6} = 1$

$\frac{2}{6} + \frac{3}{6} = \frac{5}{6}$ $\frac{6}{6} - \frac{1}{6} = \frac{5}{6}$ $\frac{4}{6} + \frac{2}{6} = \frac{6}{6}$

Derive sixths from thirds by dividing a rectangular region first into thirds and then into halves. Name each part $\frac{1}{6}$.



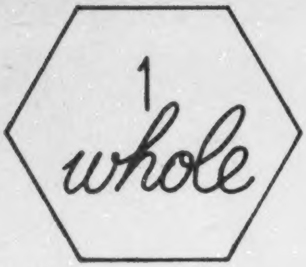


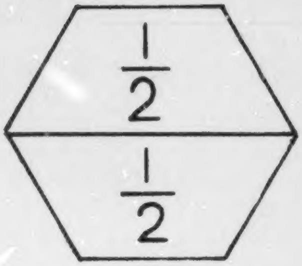
Compare thirds with sixths. Write mathematical sentences to describe relationships.

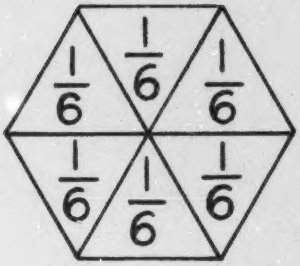
$\frac{1}{6} < \frac{1}{3}$ $\frac{1}{3} = \frac{2}{6}$ $\frac{2}{3} = \frac{4}{6}$ $\frac{3}{3} = \frac{6}{6}$ $\frac{6}{6} = 1$

Since $\frac{3}{3} = \frac{6}{6}$ and $\frac{6}{6} = 1$ then $\frac{3}{3} = 1$.

Compare sixths with halves.





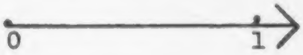


If the hexagon is one or a whole then the trapezoid is $\frac{1}{2}$ of the hexagon and the triangle is $\frac{1}{6}$ of the hexagon. Compare sixths with halves and write mathematical sentences to show relationships.

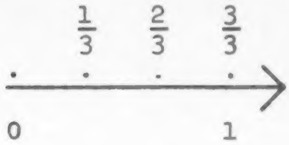
$\frac{1}{6} < \frac{1}{2}$ $\frac{2}{6} < \frac{1}{2}$ $\frac{3}{6} = \frac{1}{2}$ $\frac{4}{6} > \frac{1}{2}$

$\frac{2}{2} = \frac{6}{6}$ $\frac{1}{2} + \frac{3}{6} = \frac{6}{6} = 1$

Name thirds on a number ray of number line. Discuss naming the endpoint zero and the point to the right of zero 1.



Divide the segment between 0 and 1 into 3 equivalent parts.



Discuss:
- names for points between 0 and 1
- the length from zero to $\frac{1}{3}$ as one third of the distance between zero and 1, the length from zero to $\frac{2}{3}$ as two thirds of the distance between zero and 1, and so forth.
- $\frac{3}{3}$ as another name for one or a whole

**

UNIT 30. OPERATIONS: FRACTIONAL NUMBERS

Reinforce finding $\frac{1}{2}$ of a number.

Develop finding: $\frac{1}{3}$ and $\frac{1}{6}$ of sets of objects

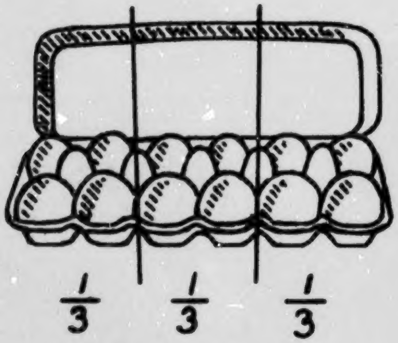
$\frac{1}{3}$ and $\frac{1}{6}$ of a number

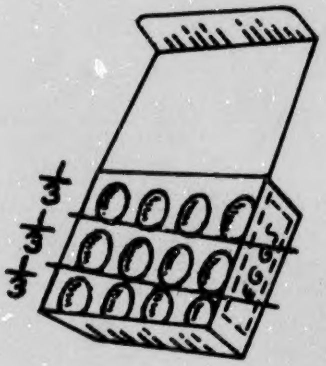
Suggestions for Pupil Activities

Adapt learning activities in Unit 10.

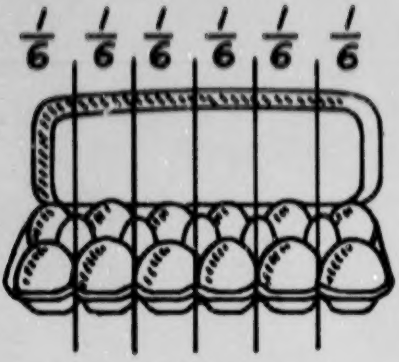
Additional Suggestions

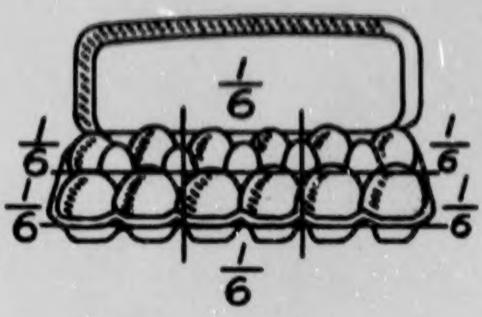
Use egg cartons, six-pack holders and other similar materials to show fractional parts of a number of things. Show ways of separating cartons into three equivalent parts.





12 egg sections
4 egg sections in each third
$\frac{1}{3}$ of 12 = 4
4 is one third of 12





12 egg sections
2 egg sections in each sixth
$\frac{1}{6}$ of 12 = 2
2 is one sixth of 12

***

UNIT 31. MEASUREMENT: MONEY

Reinforce understanding of relationships among the following: penny, nickel, dime, quarter, half-dollar, and dollar.

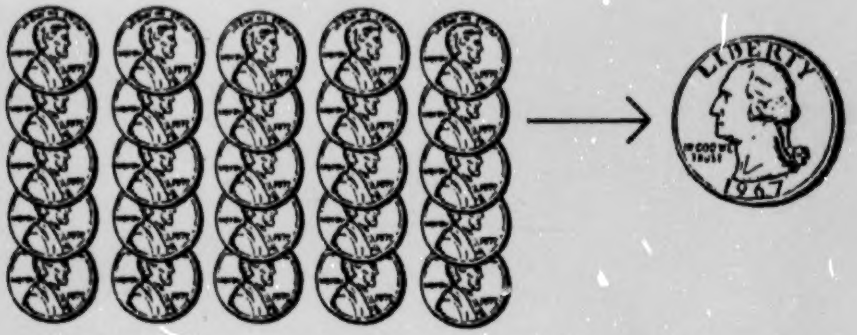
Suggestions for Pupil Activities

Use collections of coins to explore money values. Include pennies, nickels and dimes. Sort the coins according to value in a muffin tin, egg cartons, or other divided boxes.

Summarize the total value of each assortment of coins.

Dimes	Nickels	Pennies	Value
2	1	3	28¢
1	3	4	29¢
4	5	11	76¢

Use sets of coins to picture relationships among pennies, nickels and quarters. To identify coins that are equivalent in value to a quarter, arrange 25 pennies in piles of 5 pennies each. Determine the value of the set. Find one coin that has the same value as the collection of 25 pennies.



25 pennies
25¢

1 quarter
25¢

Replace each pile of 5 pennies with one coin of the same value. Determine the value of the set. Find the one coin that has the same value as the collection of 5 nickels.

5 cents

5¢

5 cents

5¢

5 cents

5¢

5 cents

5¢

5 cents

5¢

1 quarter

Summarize: 25 pennies = 1 quarter
5 nickels = 1 quarter

TEACHER'S NOTES

Adapt the previous activities to identify coins that are equivalent in value to one dollar. Record the result in chart form.

Coins	Value
100 pennies	100¢
10 dimes	100¢
20 nickels	100¢
4 quarters	100¢
2 half dollars	100¢
1 dollar	100¢

1 dollar

100 cents
100¢

Introduce naming amounts of money in dollars and cents. Work with collections of bills, dimes and pennies. Determine the value of each collection and record it on a chart.

Dollars	Dimes	Pennies	Value
2	1	5	215¢
1	3	0	130¢
3	0	7	307¢
0	7	5	75¢

Discuss recording the amounts of money using the dollar sign and point.

215¢ = $ 2.15

symbol for dollars ---┘ (points to $)

the point separates the numerals for the dollars from the numerals for the dimes and pennies.

Use the fewest possible coins and/or bills to show the following:

64¢ 93¢ 136 cents $2.13

Make charts showing different sets of coins which have the same value.

76¢

Quarters	Dimes	Nickels	Pennies
3			1
	7	1	1
	7		6
2	1	3	1

Solve word problems about money.

There is a candy machine in Juan's school that gives back change from a quarter or a half-dollar. There are no pennies in the machine. Each piece of candy costs 10¢. Yesterday Juan bought a peanut bar. He put 50¢ in the machine.

How much change did the machine return?

List 5 ways in which the machine could have returned his change:
1. 2 dimes and 4 nickels
2.
3.
4.
5.

UNIT 32. NUMERATION: DOLLARS AND CENTS SYSTEM

Develop counting and recording money values using a dollar sign and point, e.g., $3.45.

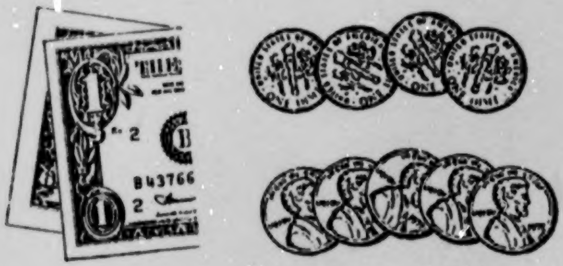
Suggestions for Pupil Activities

Estimate, count, and record the amount of money placed in see-through bags.

A possible sequence follows:

- Pennies only
- Dimes only
- Nickels only
- Quarters only
- Dimes, pennies, and bills
- Dimes, nickels, and pennies
- Quarters, dimes, nickels, pennies, etc.

Discuss various ways of counting as well as different ways of recording the amounts.



	Dollars	Dimes	Pennies	
145¢	1	4	5	$1.45

Practice making change in a classroom store. Spend 38 cents. Give the storekeeper a half-dollar. Storekeeper may count out the change as follows:
39 cents, 40 cents, 50 cents.
39 cents, 40 cents, 45 cents, 50 cents.

Discuss: the amount of change.
the coins received in change.

Complete the chart. Write the total value of each set in dollar and cent notation.

Dollars	Dimes	Pennies	Value
1	3	6	$1.36
3	7	9	
5	2	0	
2	0	8	
0	4	3	

TEACHER'S NOTES

**

UNIT 33. ADDITION AND SUBTRACTION OF WHOLE NUMBERS

Using experiences, develop skill in computing sums and differences in dollars and cents system.

Suggestions for Pupil Activities

Collect price lists, advertisements, catalogues, etc. Choose two items. Estimate the total cost. Compute the cost.

$2.49

$1.35

$\$2.49 + \$1.35 = \square$

$2.49 is ____ cents
$1.35 is ____ cents

$$\begin{array}{r} 249 \\ +\ 135 \\ \hline 384 \end{array} \text{ cents}$$

384 cents = ☐ dollars and △ cents or $3.84

Compare:

$$\begin{array}{r} 249 \\ +\ 135 \\ \hline 384 \end{array} \text{ cents} \qquad \text{with} \qquad \begin{array}{r} \$2.49 \\ +\ 1.35 \\ \hline \$3.84 \end{array}$$

Investigate the difference in the cost of two items. Estimate the difference. Compute the difference.

$$\begin{array}{r} \$\ 3.98 \\ -\ \underline{2.52} \end{array}$$

$$\begin{array}{r} \$\ 3.98 \\ \underline{-2.52} \end{array} \begin{array}{c} \longrightarrow \\ \longrightarrow \end{array} \begin{array}{rl} 398 & \text{cents} \\ -\ \underline{252} & \text{cents} \\ 146 & \text{cents} \end{array}$$

$$146 \text{ cents} = \square \text{ dollars and } \triangle \text{ cents}$$
$$146 \text{ cents} = \$1.46$$

Compare:

$$\begin{array}{rl} 398 & \text{cents} \\ \underline{-\ 252} & \underline{\text{cents}} \\ 146 & \text{cents} \end{array} \qquad \text{with} \qquad \begin{array}{r} \$3.98 \\ \underline{-2.52} \\ \$1.46 \end{array}$$

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UNIT 34. GEOMETRY

Reinforce understanding of curve, closed curve, simple closed curve. Develop concept of polygon. Discover properties of different polygons: triangle, square, rectangle and other quadrilaterals.

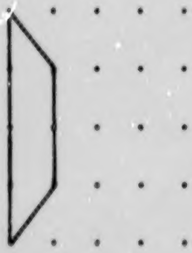
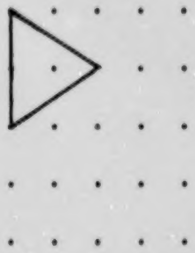
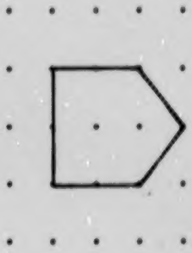
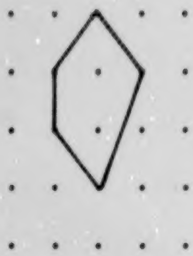
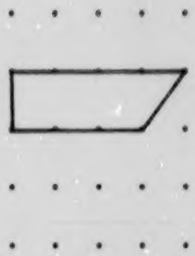
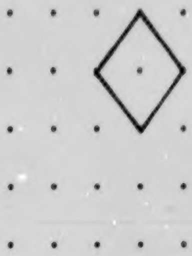
Suggestions for Pupil Activities

Adapt learning activities in Unit 18.

Additional Suggestions

Use geoboards and rubberbands, geostrips, straws of various lengths, cardboard strips and fasteners, pipe cleaners, soft wire and other similar materials.

Form simple closed curves composed of line segments (polygon).

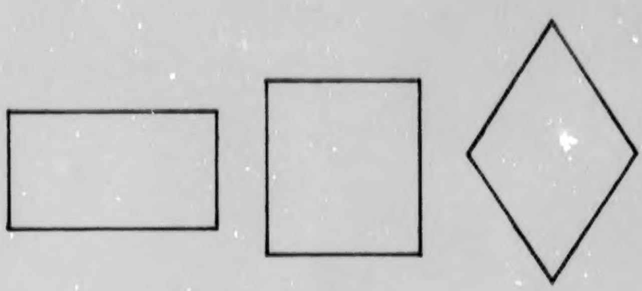
Construct and complete charts.

Number of Sides (Line Segments)	Number of Corners (Angles)	Name
3	3	Triangle

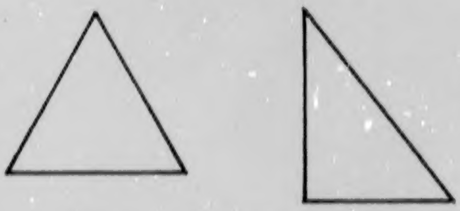
Experiment with a geoboard and rubberbands to make different four-sided figures (quadrilaterals). Copy the shapes on dot paper. Discuss similarities and differences.

Trace around attribute blocks, pattern blocks and other similar materials to form plane figures. Classify shapes by the number of sides.

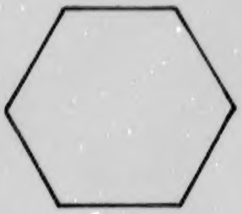
4 sides



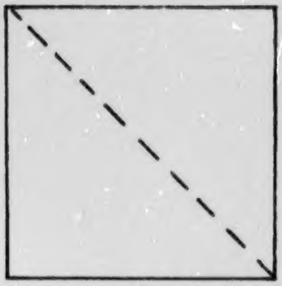
3 sides



6 sides

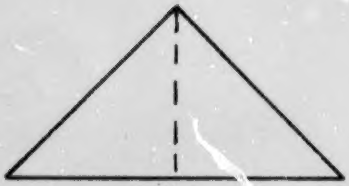


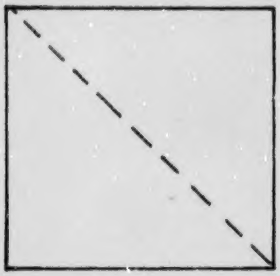
Use a 4-or a 5-inch square made of oaktag or construction paper. Cut on the diagonal to form two triangles.

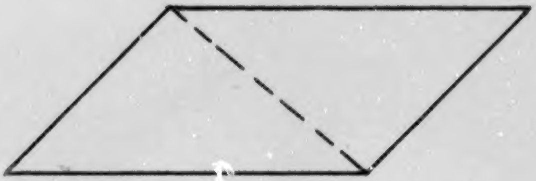


Experiment with the two triangles to form:

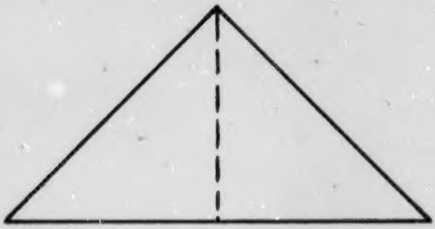
a larger triangle
a square
a four-sided shape that is not a square
   or a rectangle





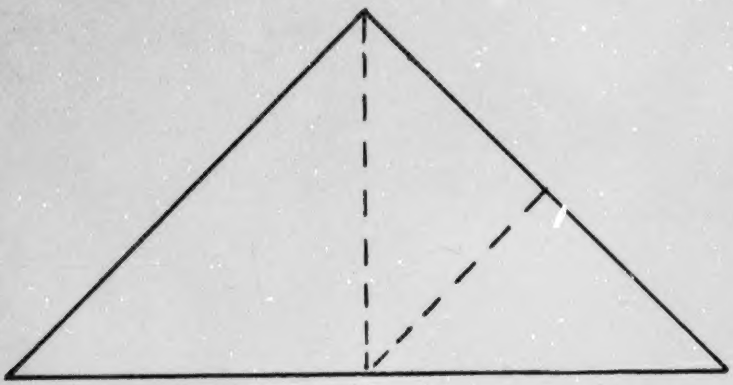


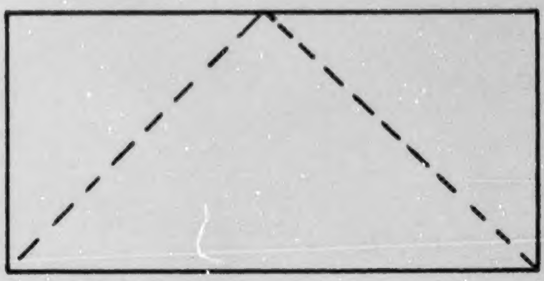
Cut one of the triangles in half as shown.

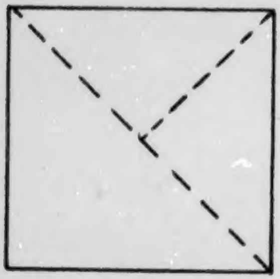


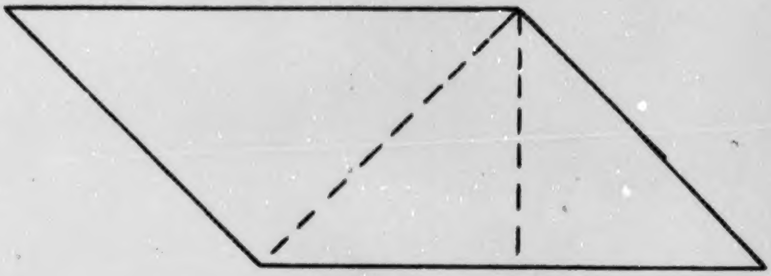
Experiment with all three pieces to form:

- a larger triangle
- a rectangle
- a square
- four-sided shapes that are not squares or rectangles

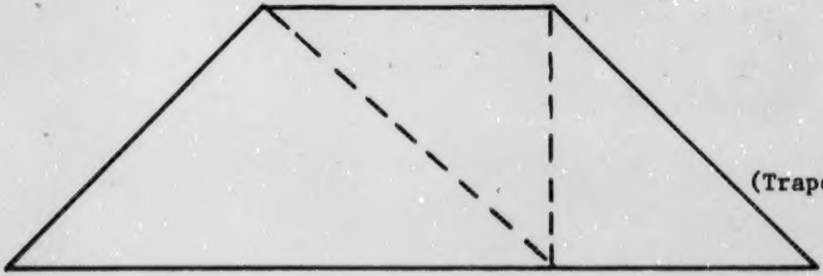








(Parallelogram)



(Trapezoid)

[redacted]

UNIT 35. MULTIPLICATION OF WHOLE NUMBERS

Reinforce multiplication facts for twos, for threes, for fours through 5 fours, for fives through 5 fives. Develop facts for fours through 9 fours, for fives through 9 fives. Record horizontally and vertically.

Observe and use the commutative property of multiplication.

Suggestions for Pupil Activities

Adapt learning activities in Units 7, 15, and 27.

Additional Suggestions

Play "Guess My Rule."

Teacher thinks of a rule, e.g., multiply by 3.

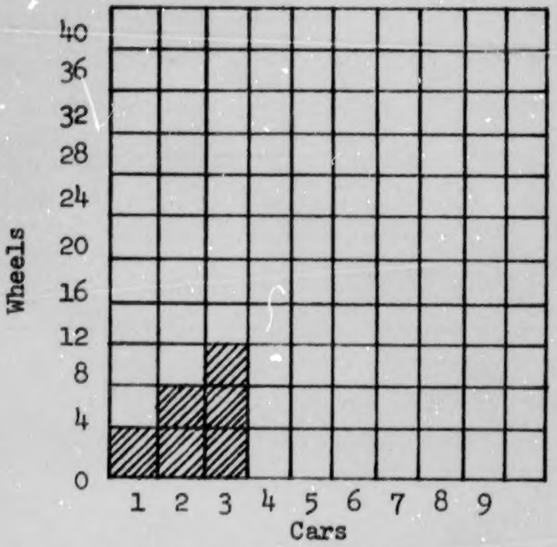
Children give □ number.
Teacher gives △ number.

□	△
3	9
5	15
6	18

etc.

Discuss: the relationship between □ and △
the open sentence which fits all cases □ x 3 = △

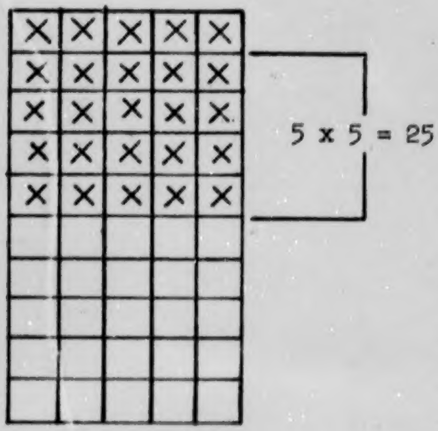
Develop a graph involving facts of four:



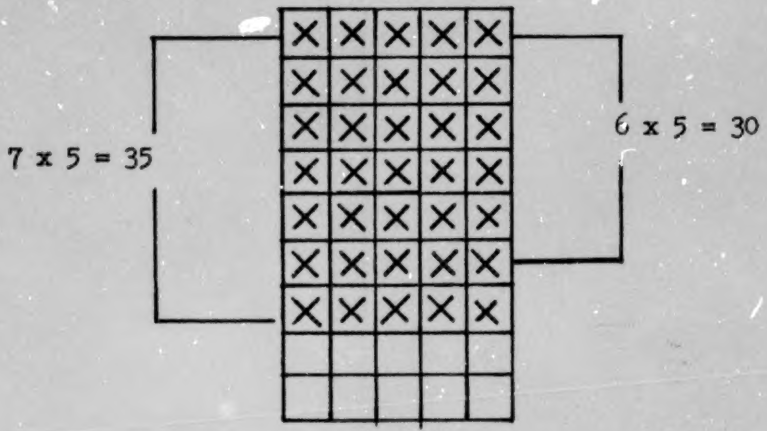
Interpret the graph to complete the table.

Cars	1	2	3	4	5	6	7	8	9
Wheels	4	8							

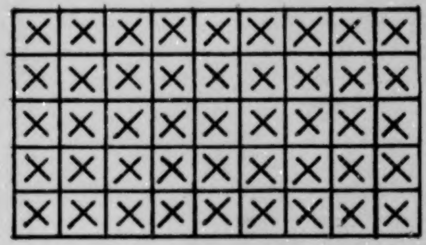
Use $\frac{1}{2}$ or $\frac{1}{4}$ inch graph paper to show a 5 x 5 array. Write a multiplication sentence that describes the array.



On the same graph paper extend the array to include first 6 x 5 then 7 x 5 and so on through 9 x 5. Write a multiplication sentence that describes each succeeding array.

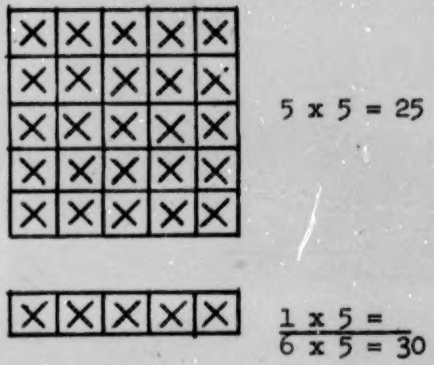


Turn the array to visualize that 9 x 5 = 5 x 9.

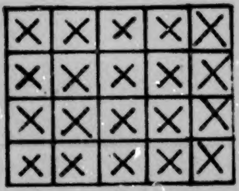


Explore various ways of deriving products from known products by using arrays, graph paper, unifix materials, multibase arithmetic blocks, and other similar materials.

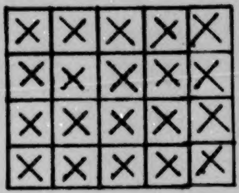
Adding 1 set of five



Doubling sets of five



4 x 5 = 20



4 x 5 = 20

8 x 5 = 40

Summarize the facts for fours and for fives on a chart. Look for interesting number patterns.

x	1	2	3	4	5	6	7	8	9
4	4	8	12						
5					25				45

**

UNIT 36. DIVISION OF WHOLE NUMBERS

Reinforce facts for twos, for threes,
for fours through the number of fours in 20
for fives through the number of fives in 25

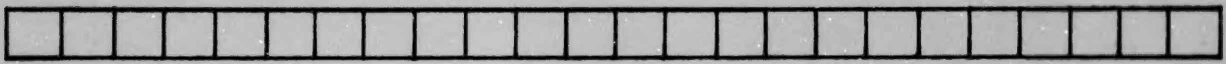
Develop facts for fours in 24; in 28; in 32; in 36
for fives in 30; in 35; in 40; in 45

Suggestions for Pupil Activities

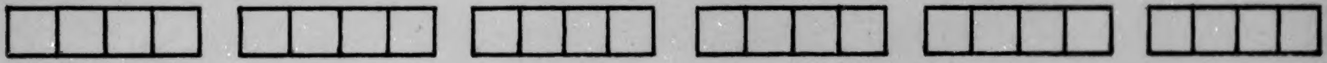
Adapt learning activities in Units 8, 16, and 28.

Additional Suggestions

With interlocking cubes form a train 24 cubes long.



Separate the train into cars of 4 cubes each.

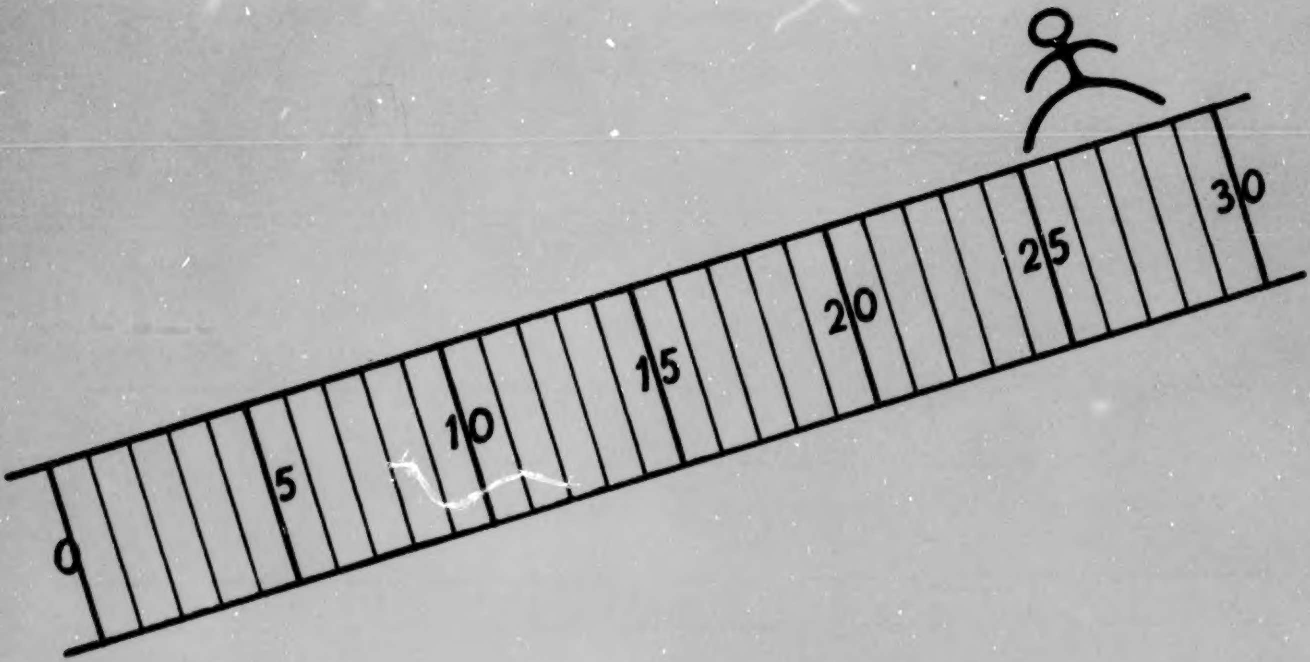


Discuss: the number of fours in 24

division notations

$\square \times 4 = 24$ $24 \div 4 = \square$ $4\overline{)24}$

Use a number ladder to practice division facts.



Follow directions such as:

> Start at 30.
> How many steps of five to get to 0? (6)
> Write a division sentence that describes the moves on the ladder.
>
> $30 \div 5 = 6.$

Application
At McDonald's, Lila bought a bag of french fries to share with her four friends. There were 35 pieces of potato in the bag. How many pieces did each child get?

Pieces of potato	35
Children (Lila and four friends)	5

$35 \div 5 = \square$ or $5\overline{)35}$

UNIT 37. NUMBER: FRACTIONAL NUMBERS

Reinforce concept of halves and fourths of a whole.

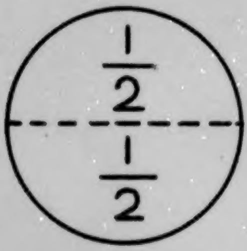
Develop: concept of eighths of a whole
understanding of equivalence: halves, fourths, eighths

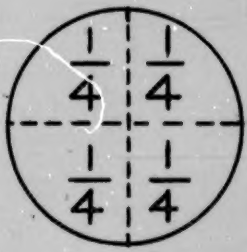
Suggestions for Pupil Activities

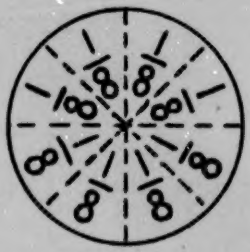
Adapt learning activities in Units 10 and 29.

Additional Suggestions

Fold paper shapes to show halves, fourths, and eighths. Label each part. Cut on each fold. Match eighths with fourths and halves.





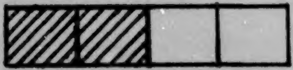


Express the relationships as follows:

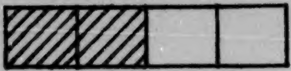
$\frac{2}{8} = \frac{1}{4}$ $\frac{4}{8} = \frac{1}{2}$ $\frac{6}{8} = \frac{3}{4}$

Interpret diagrams and complete charts.

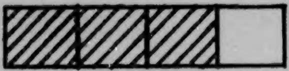
a.



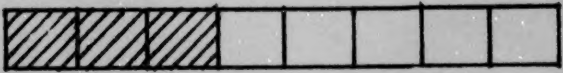
b.



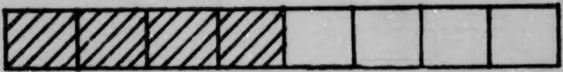
c.



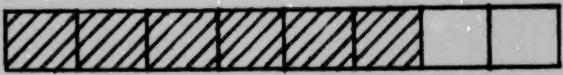
d.



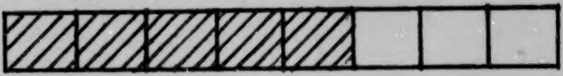
e.



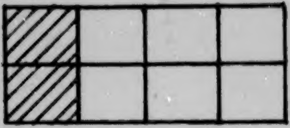
f.



g.



h.



	Shaded	Not Shaded
a.	$\frac{2}{4}$ or $\frac{1}{2}$	$\frac{2}{4}$ or $\frac{1}{2}$
b.		
c.		
d.		
e.		
f.		
g.		
h.		

Use games such as the one below to develop skill in renaming fractions.

Name the fractions and spell a word.

J	N	C	T	P	I	E	M	L
0	$\frac{1}{8}$	$\frac{2}{8}$	$\frac{3}{8}$	$\frac{4}{8}$	$\frac{5}{8}$	$\frac{6}{8}$	$\frac{7}{8}$	1

Find the fraction on the number line that is equivalent to $\frac{1}{2}$. **Since** it is located at point P, a P has been placed in the indicated space **below.** Do the same for $\frac{3}{4}, \frac{1}{8}, \frac{1}{4}, \frac{5}{8}, \frac{4}{4}$

The word is P _ _ _ _ _.

TEACHER'S NOTES

■■

UNIT 38. OPERATIONS: FRACTIONAL NUMBERS

Reinforce finding $\frac{1}{4}$ of a number. Develop finding $\frac{1}{8}$ of a number.

Suggestions for Pupil Activities

Adapt learning activities in Units 10 and 30.

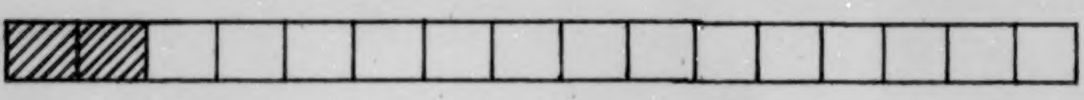
Additional Suggestions

Write word problems about distributing, collecting or sharing 8, 16, 24, etc. things among eight children. Demonstrate and solve the problems. Record the results.

16 cubes
each child received one eighth of the set of cubes or two cubes
two cubes in each eighth
$\frac{1}{8}$ of 16 = 2
2 is one eighth of 16

Cut strips of centimeter graph paper into lengths of 8, 16, 24, etc. units. Shade $\frac{1}{8}$ of each strip.

Discuss: what part of the set of 16 squares is shaded
how many centimeter squares are in the shaded part



$\frac{1}{8}$ of 16 = 2

###

UNIT 39. MEASUREMENT: LINEAR

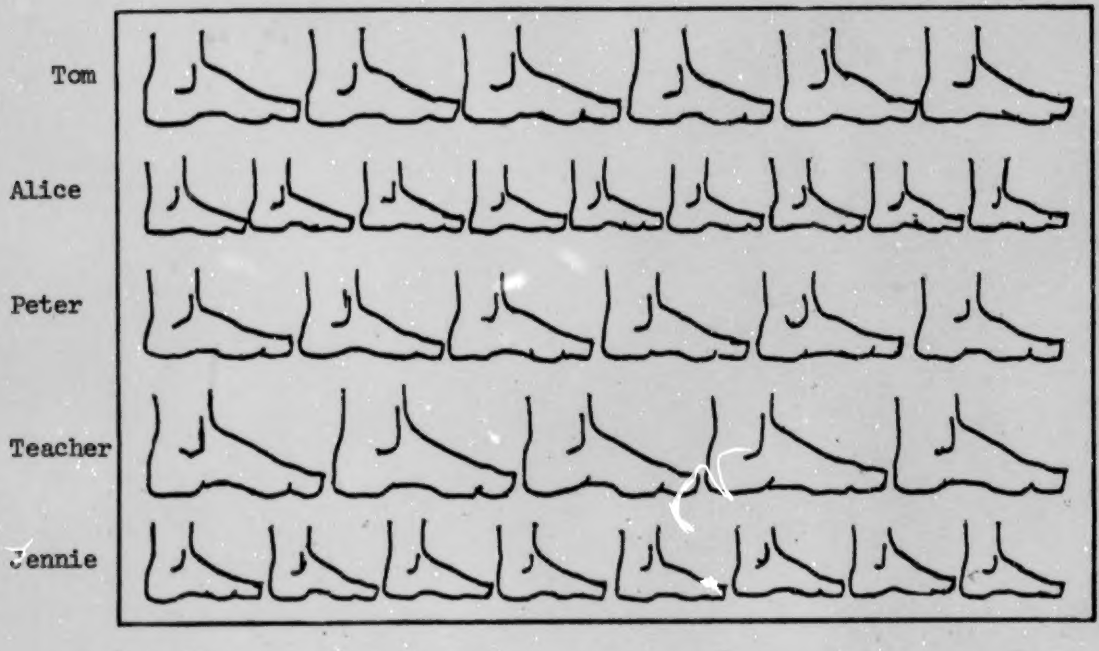
Using experiences, reinforce and/or develop inch, foot, yard.

Introduce metric units of length as other units of measure: centimeter, meter.

Suggestions for Pupil Activities

Experiment with nonstandard units such as: sticks, straws, inch blocks, clips, pieces of ribbon or string to measure the length of objects. Graph the results.

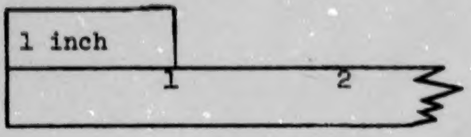
The Width of the Hall Measured in Footsteps



Did everybody get the same measurement?
What does this tell us about our foot measures?

Discuss the need for standard units of measure.

Use an inch unit and a 12-inch strip of oaktag to make an inch-foot ruler.

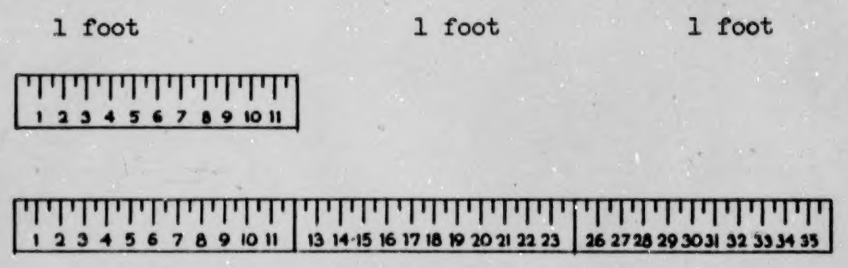


Discuss the relationship between 12 inches and 1 foot.

Use the inch ruler to measure various objects in the classroom. Construct and complete charts.

Object	Estimate	Measure
Crayon	____inches	____inches
Pen		
Book		

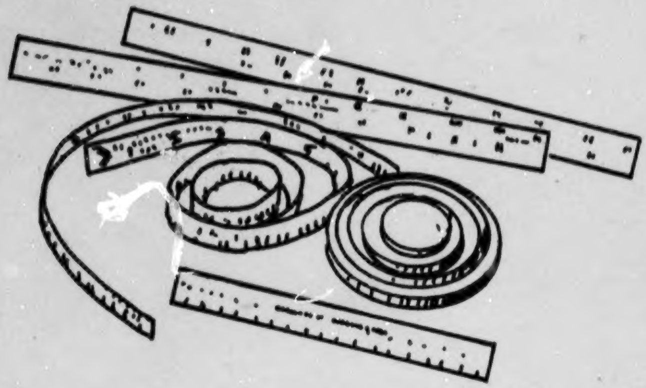
Use a foot ruler to make a yardstick.

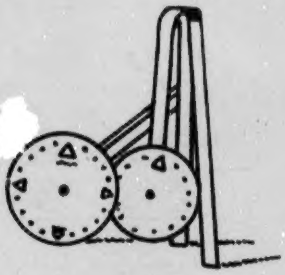


Discuss: A yardstick is as long as 3 foot rulers.
A yard is 12 inches + 12 inches + 12 inches or 36 inches.

Measure the bulletin board, chalkboard, or teacher's desk using first the inch-foot ruler, then the yardstick. Compare measurements. Discuss which unit of measure is most suitable.

Estimate the length of the classroom in yards. Check the estimate by using a yardstick, a trundle wheel, a piece of string 1 yard long and/or a cloth measuring tape.





Measure other lengths in this way. Decide which measuring instrument is easier or more convenient to use.

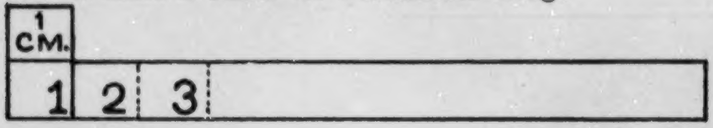
List objects that are usually measured in inches; in feet; in yards.

Things Measured in Inches	Things Measured in Feet	Things Measured in Yards
Pencil	Table	Carpet

Note: The following activities are designed to guide you and the pupils to think metric. Experiences in measuring length are given to introduce students to the concepts and to the common units of meter (m) and centimeter (cm). At this time no attempt should be made to teach prefixes and to make conversions either within the metric system or in relation to the customary units.

Using colored rods, measure lengths in centimeter. The length of one of the white rods is one centimeter.

Use a white rod and a strip of oaktag the length of an orange rod to make a ruler 10 centimeter long.



Use the centimeter ruler to measure: the width of your thumb; a paper clip; colored rods; your pen; a book; your waist. Record the measurements in centimeters.

Find some objects in the classroom and guess whether they are 10 centimeters long, less than 10 centimeters, or more than 10 centimeters. Check your estimate by measuring each object with a centimeter ruler. Make a chart of the results.

Object	My Estimate	10 cm long	Shorter than 10 cm	Longer than 10 cm
Pair of scissors	10 cm			x

Discuss the completed charts and develop the idea that things longer than 10 cm can be measured with a unit called the meter.

A meter stick may be constructed out of oaktag. Prepare 5 rectangular regions, each 20 centimeters long. (Do not indicate centimeter markings.) Tape the regions end to end. The length of the measuring stick is 1 meter (m).

Collect objects that are about 1 meter long.

Use meter sticks to measure each other's heights. Cut strings to represent the measurements. Tape the strings on a bulletin board to form a "bar" graph of Our Heights in Meters.

Use a game approach to teach the centimeter-meter relationship.

Oral review of the value of each cuisenaire rod in centimeters

If the white rod is one centimeter long, how long is the yellow rod? the black? the blue? the orange? etc.

How long is a red and orange?

A yellow and blue?

A purple and black?

Play the game as follows.

Two or three players throw dice to see who can throw 100 centimeters (1 meter) first. The first player throws a pair of dice, notes the number and take an equivalent number in cuisenaire rods. For example, if the 6 turned up on 1 die and 4 on the other, the player would take 10 cm in cuisenaire rods, any combination, and begin a train on his desk. The second player then takes his throw and begins his train, etc. They continue to throw the dice in turn and add on to their trains until one player has a train of one hundred centimeters (1 meter) They may measure their trains with a meter stick or with a metric tape to see if they have added correctly.

Note: A spinner may be used instead of dice.

**

UNIT 40. MULTIPLICATION OF WHOLE NUMBERS

Reinforce facts for twos, for threes, for fours, for fives. Develop facts for sixes through 9 sixes.

Using the distributive property of multiplication over addition, extend multiplication beyond 9 fours, 9 fives.

Observe and use the commutative property of multiplication.

Suggestions for Pupil Activities

Adapt learning activities in Units 7, 15, 27, and 35.

Additional Suggestions

Develop and complete a sequence.

Since 2 x 4 = 8

SO

4 x 4 = 8 + ☐ or ______

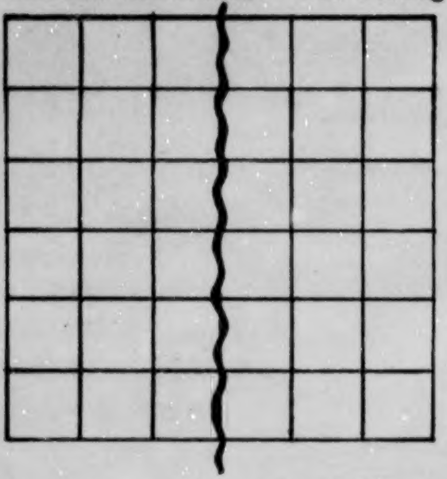
8 x 4 = 16 + ☐ or ______

16 x 4 = 32 + ☐ or ______

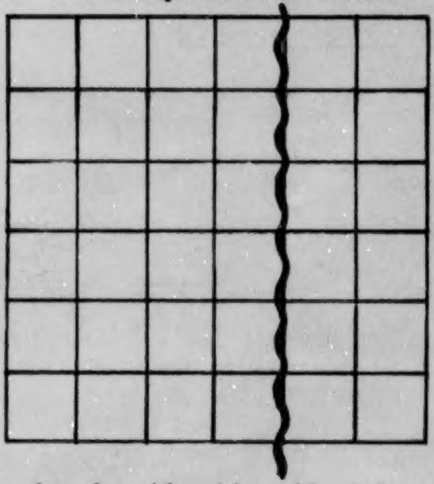
Discuss the pattern. Continue as far as you can go.

TEACHER'S NOTES

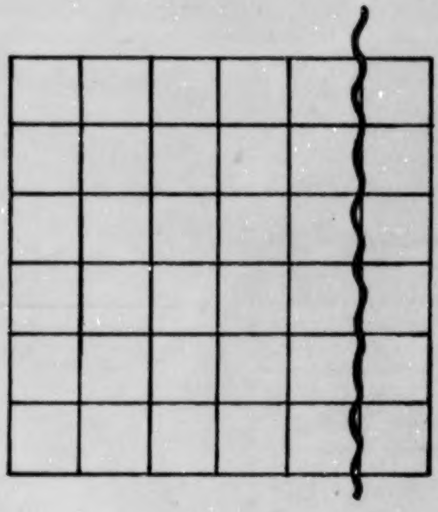
Show different ways of renaming the second factor. Form arrays using bottle tops, graph paper, geoboards, cubes, discs, or any similar materials. Use string to separate the arrays into subsets.



$$\begin{aligned} 6 \times 6 &= (6 \times 3) + (6 \times 3) \\ &= 18 + 18 \\ &= 36 \end{aligned}$$



$$\begin{aligned} 6 \times 6 &= (6 \times 4) + (6 \times 2) \\ &= 24 + 12 \\ &= 36 \end{aligned}$$



$$\begin{aligned} 6 \times 6 &= (6 \times 5) + (6 \times 1) \\ &= 30 + 6 \\ &= 36 \end{aligned}$$

**

UNIT 41. DIVISION OF WHOLE NUMBERS

Reinforce facts for twos, for threes, for fours, for fives. Develop facts for sixes through number of sixes in 54.

Suggestions for Pupil Activities

Adapt learning activities in Units 8, 16, 28, and 36.

Additional Suggestions

Explore cutting various lengths of tape, ribbon or string into pieces of equivalent lengths to identify number of sixes in 12, 18, 24...54.

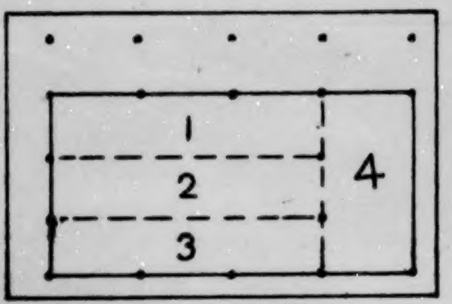
12 centimeters

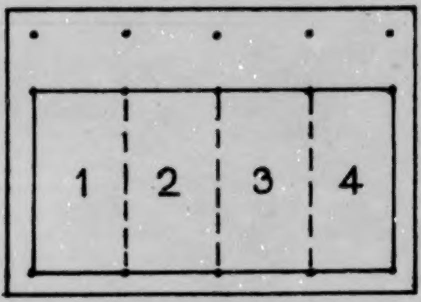
How many 6 cm pieces can you get from a 12 cm piece of ribbon?

$\square \times 6 = 12$ $\quad 12 \div 6 = \square$ $\quad 6\overline{)12}$

Explore division using the geoboard (dot paper may also be used).

a. Using □ as a square unit, how many rectangles of 3 square units can you get from a rectangle of 12 square units?





b. Divide a 12-unit rectangle into rectangles of 4 square units. How many rectangles?

$\square \times 4 = 12$ $\qquad 12 \div 4 = \square$ $\qquad 4\overline{)12}$

Proceed as above with other rectangles.

TEACHER'S NOTES

UNIT 42. NUMERATION: ROMAN NUMERALS

Use activities to reinforce the repetitive, additive, and subtractive principles of the Roman system of numeration. Use Roman numerals I, V, X to represent numbers.

Suggestions for Pupil Activities

Use toothpicks, felt letters, magnetic letters or oaktag strips to construct the Roman numerals for the Hindu-Arabic numerals 1, 2, 3, 5, 10.

Record the results in chart form.

Our Numeral	1	2	3	5	10
Roman Numeral	I	II	III	V	X

Derive symbols for 6, 7, and 8 using the letters V and I. Discuss the meaning of each numeral.

Our Numeral	Roman Numeral	Meaning
6	VI	6 is 5 + 1
7	VII	7 is 5 + 1 + 1
8	VIII	8 is 5 + 1 + 1 + 1

Combine letters I, V and X to form Roman numerals for 4 and 9.

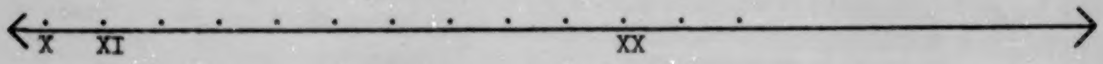
Make reference to the following ideas:

- One more than 5 is 6. The Roman numeral for 6 is VI. In VI the I comes after the V.
- One less than 5 is 4. The Roman numeral for 4 is IV. In IV the I comes before the V.

Combine letters I and X to show that XI means 10 + 1 or 11 and that IX means 10 - 1 or 9.

- I and X can be used repetitively, not V.

Form Roman numerals 1 through 39 according to the procedures described in this unit. Use those Roman numerals to name points on a number line.



Complete a calendar page using Roman numerals.

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
			I	II	III	IV
V	VI					

Collect materials that show use of Roman numerals, e.g., clock faces, dates, chapter headings in books, etc.

**

UNIT 43. MULTIPLICATION OF WHOLE NUMBERS

Reinforce multiplication facts developed in previous units. Develop facts for sevens through 9 sevens.

Using the distributive property of multiplication with respect to addition, extend multiplication beyond 9 sixes.

Observe and use the commutative property of multiplication.

Suggestions For Pupil Activities

Adapt learning activities in Units 7, 15, 27, 35, and 40.

Additional Suggestions

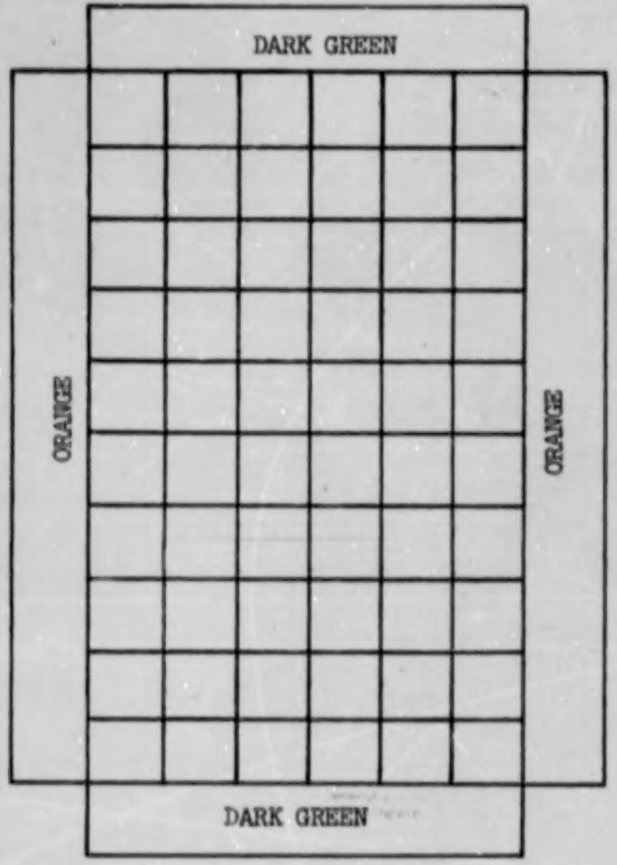
Derive the facts of seven through the use of a calendar. Discuss number of days in one week, two weeks, three weeks, etc. Construct and complete a chart.

Weeks	1	2	3	4	5	6
Days	7	14				

Write multiplication sentences to describe the relationship between weeks and days. For example: 1 x 7 = 7   2 x 7 = 14

TEACHER'S NOTES

Use masking tape or colored rods to enclose various arrays of floor tiles, centimeter squares, or other similar objects.



Develop multiplication equations for the array enclosed by two dark green rods and two orange rods.

10 x 6 = 60 or 6 x 10 = 60

Name products for sevens through 9 sevens on a grid.

x	1	2	3	4	5	6	7	8	9
1							7		
2							14		
3							21		
4							28		
5							35		
6							42		
7	7	14	21	28	35	42	49	56	63
8							56		
9							63		

Solve equations.

5 x 7 = ☐ 4 x 7 = ☐ 8 x 7 = ☐ 7 x 6 = ☐

☐ x 7 = 35 ☐ x 7 = 28 7 x 8 = ☐ ☐ x 6 = 42

Find products.

$\begin{array}{r} 7 \\ \underline{\times\ 7} \end{array}$ $\begin{array}{r} 2 \\ \underline{\times\ 7} \end{array}$ $\begin{array}{r} 9 \\ \underline{\times\ 7} \end{array}$

**

UNIT 44. DIVISION OF WHOLE NUMBERS

Reinforce division facts developed in previous units. Develop facts for sevens through the number of sevens in 63.

Suggestions for Pupil Activities

Adapt learning activities in Units 8, 16, 28, 36, and 41.

Additional Suggestions

Refer to the facts of seven depicted on the grid suggested in Unit 43 and complete this chart.

Product	28	49	35	14
One factor	7	7	7	7
Missing factor				

Develop patterns in division. Use a calendar to visualize the number of weeks in 7 days, 14 days, 28 days, 56 days.

Record the data in chart form.

Days	Weeks
7	1
14	
28	
56	

What is the pattern? What number would you write below 56?

**

UNIT 45. ADDITION OF WHOLE NUMBERS

Develop skill in adding two addends, each expressed by a three-digit numeral, with two exchanges, 10 ones for 1 ten and 10 tens for 1 hundred.

Suggestions for Pupil Activities

Adapt learning activities in Unit 22 to compute sums for examples such as:

$386 + 257 = \boxed{}$ $\qquad$ $\begin{array}{r} 696 \\ +\ 284 \\ \hline \end{array}$

Additional Suggestions

Add using standard form.

$$\begin{array}{r} 386 \\ +\ 257 \\ \hline 3 \end{array}$$

Add the ones (6 ones + 7 ones)
13 ones = 1 ten + 3 ones
Record the 3 in the ones place

$$\begin{array}{r} 386 \\ +\ 257 \\ \hline 43 \end{array}$$

Add the tens (1 ten + 8 tens + 5 tens)
14 tens = 1 hundred + 4 tens
Record the 4 in the tens place

$$\begin{array}{r} 386 \\ +\ 257 \\ \hline 643 \end{array}$$

Add the hundreds (1 hundred + 3 hundreds + 2 hundred)
6 hundreds = 600
Record the 6 in the hundreds place

Investigate computing sums on desk calculators. Observe the exchanges on regroupings.

Use partial sums form and/or standard form to compute the sums.

$\begin{array}{r} 256 \\ +\ 94 \\ \hline \end{array}$ $\qquad$ $\begin{array}{r} 342 \\ +\ 189 \\ \hline \end{array}$ $\qquad$ $\begin{array}{r} 576 \\ +\ 359 \\ \hline \end{array}$

****

UNIT 46. PROBLEM SOLVING

Develop procedures for analyzing and solving problems.

a. Review and reinforce meaning of mathematical symbols.

b. Use materials and experiences to make problems more realistic.

c. Introduce problems with insufficient and extraneous data.

Adapt learning activities in Unit 17 using greater numbers.

Suggestions for Pupil Activities

Continue to review and reinforce the meaning of mathematical symbols.

Match the term in Column II with the symbol in Column I.

Column I		Column II
$>$ ______	1.	a. is greater than
$\neq$ ______	2.	b. equal to
$=$ ______	3.	c. multiplication
$<$ ______	4.	d. find the difference
$\div$ ______	5.	e. addition
$\times$ ______	6.	f. is less than
$+$ ______	7.	g. is not equal to
$-$ ______	8.	h. division

Analyze word problems of the following types.

Missing data

Mary used three eggs to bake a cake. How many eggs are left?

- Read the problem.
- Determine what is to be found.
- Decide what number operation could be used.
- Specify which data are needed in order to write the open sentence.
- Supply the missing information.
- Write the open sentence.
- Solve the problem.

Missing question

365 newspapers sold on Sunday
627 newspapers sold on Monday

- Read the problem.
- Write questions which could be related to the numerical data: e.g., How many newspapers were sold on both days? How many more were sold on Monday?
- Write the open sentence.
- Solve the problem.

Extraneous data

We need 12 crayons for the girls and 9 crayons for the boys. There are 36 crayons in each box. How many crayons do we need?

- Read the problem.
- Determine what is to be found.
- Decide what number operation could be used.
- Specify which data are needed and which data are not needed.
- Write the open sentence.
- Solve the problem.

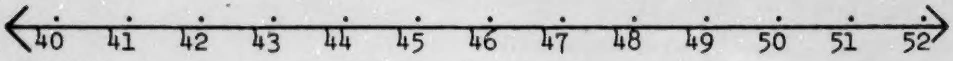
*

UNIT 47. NUMBER

Develop rounding numbers to the nearest ten and to the nearest hundred. Use these ideas to estimate sums and differences.

Suggestions for Pupil Activities

Use a number line with points marked between two multiples of ten.



Locate 42 on the number line.

Discuss: Between which two multiples of ten is 42?
Is 42 closer to 40 or to 50?
What is 42 rounded to the nearest ten?
Which numbers between 40 and 50 are closer to 40? closer to 50?
Is 45 closer to 40 or 50?
Is it midway between 40 and 50?

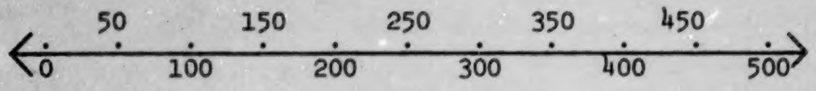
45 is rounded to 50. Conclude that a number midway between two successive tens is rounded to the greater ten.

Estimate sums before computing.

$$\text{For:}\quad \begin{array}{r} 47 \\ +\ 34 \\ \hline \end{array}$$

Discuss: What can 47 be rounded to?
What can 34 be rounded to?
What is the sum of 50 + 30?
The sum of 47 plus 34 is about _____?
Find the exact sum and discuss how close it is to the estimate.

Construct and use number lines with points marked in multiples of 100.



Locate 357 on the number line.

Investigate: Between which two multiples of 100 is 357?
Is it nearer to 300 or 400?
What is 357 rounded to the nearest hundred?
Which numbers between 300 and 400 are nearer to 300?
nearer to 400?
How would you round 350 to the nearest hundred?

Estimate differences before computing.

For: 587
- 232

Discuss: What is 587 rounded to the nearest hundred?
What is 232 rounded to the nearest hundred?
What is 600 minus 200?
587 minus 232 is about ______?
Find the exact difference and discuss how near it is to the estimate.

Estimate the answers of verbal problems.

On Monday 132 children ate lunch in the school cafeteria. On Tuesday 284 children ate lunch. About how many children ate lunch on the two days?

Through discussion and questioning elicit these ideas?

132 rounded to the nearest hundred is 100
284 rounded to the nearest hundred is 300
100 + 300 = 400
About 400 children ate lunch.

Compute to find the actual number. Compare estimate with the sum.

***

UNIT 48. MEASUREMENT: CAPACITY

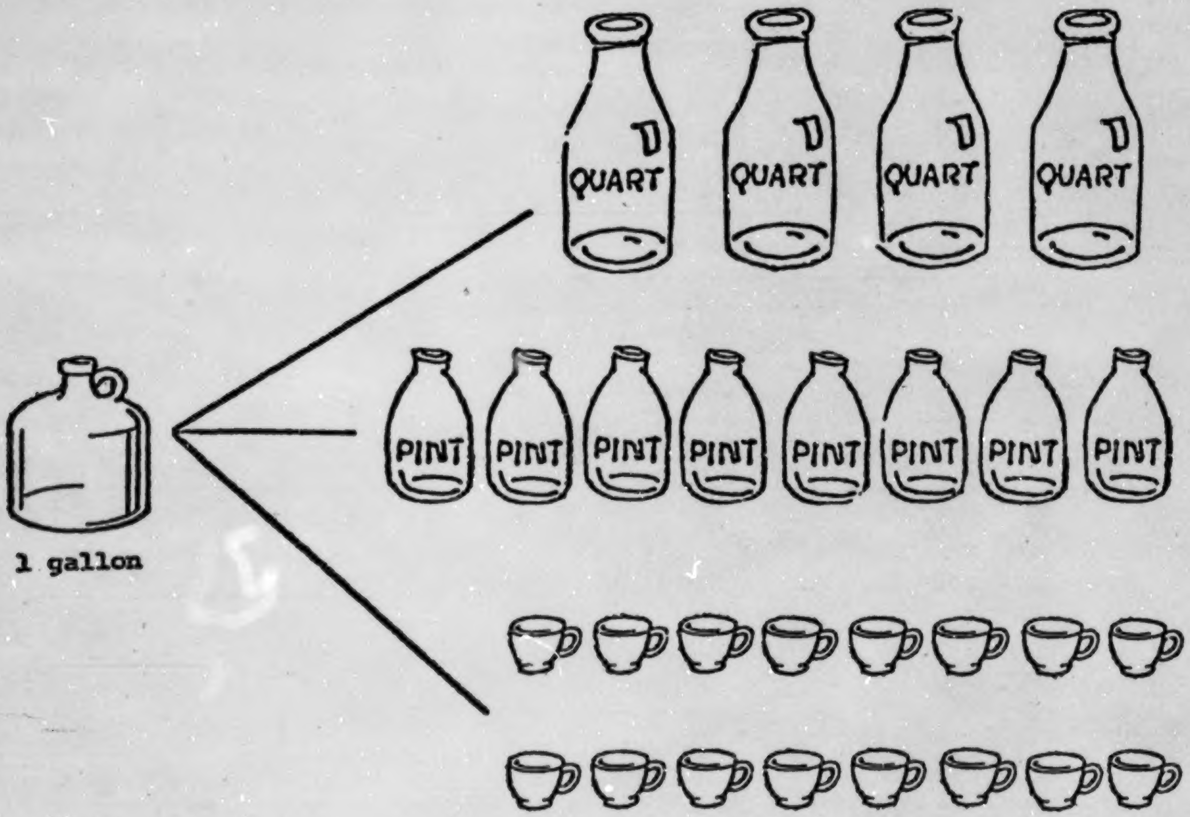
Using experiences, reinforce concept of quart, of pint, of cup, and develop concept of gallon.

Introduce metric unit of capacity - liter.

Suggestions for Pupil Activities

Determine the relationship between the gallon and the quart; between the gallon and the pint; between the gallon and the cup. Work with a set of liquid measures, a funnel and water.

Picture the relationships.



Discuss: How many cups in 1 gallon?
How many pints in 1 gallon?
How many quarts in 1 gallon?

Collect a variety of containers which hold standard units of liquid measure such as cup, pint, and quart. Experiment with water and/or sand. Complete the following:

1 pint holds ☐ cups

1 quart holds ☐ cups

1 quart holds ☐ pints

Construct charts to show the results of measuring experiences.

Cups	2	4	6	8			
Pints	1						

Quarts	Gallons
4	1
8	
12	
16	

Gallons	Quarts	Pints	Cups
1	4	8	16
2			
	12		
			64

Use symbols >, =, <, to make the statements true. Pour water or sand to check your answers. Why can the measurement be only approximate?

1 gallon ______________ 16 pints

6 cups ______________ 1 quart

8 pints ______________ 1 gallon

Investigate the number of cups in 1/2 gallon; in 1/4 gallon, in 1/2 quart; in 1/4 quart.

NOTE: The following activities are designed to guide you and the pupils to THINK METRIC. Experiences in measuring capacity are given to introduce students to the concept and to the common unit of liter (L). At this time no attempt should be made to teach prefixes and to make conversions either within the metric system or in relation to the customary units.

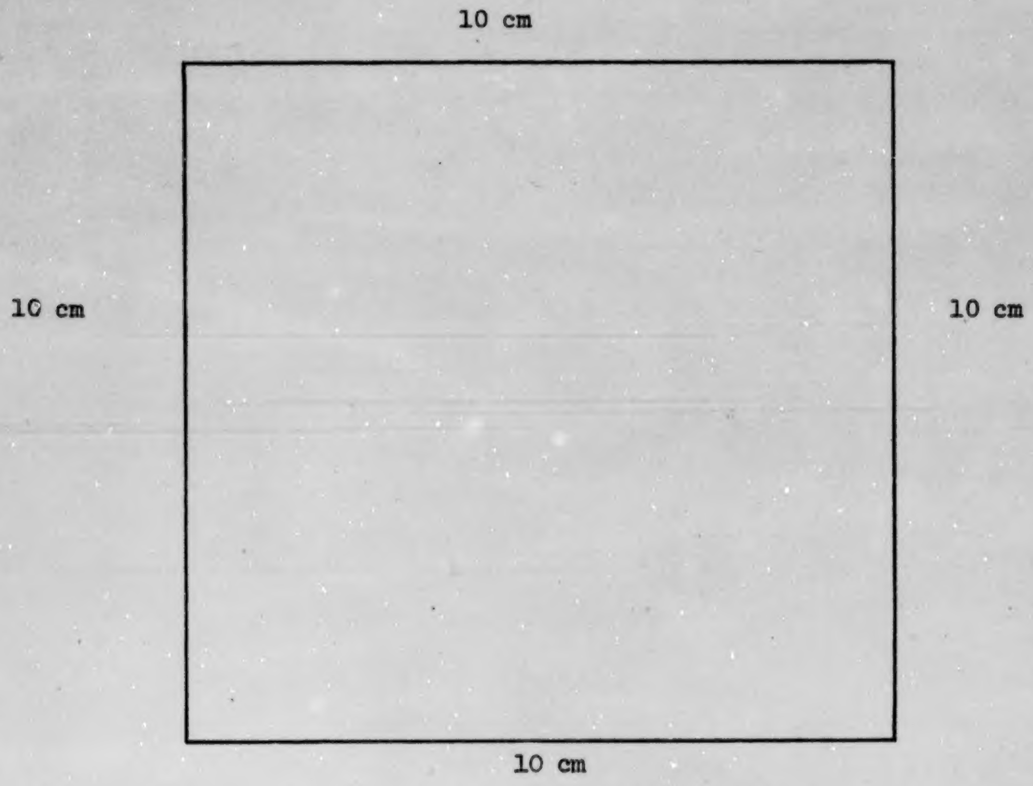
Find some containers in the classroom and guess whether they hold more than 1 liter (L) or less than 1 liter. Check your estimate by pouring water or sand from the containers into a liter measure. Record the results on a chart.

Things That Hold Less Than 1 Liter	Things That Hold More Than 1 Liter

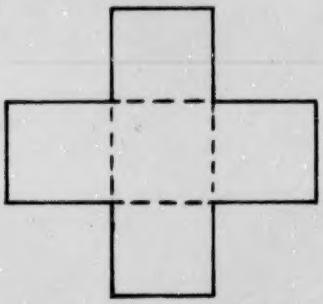
---

TEACHER'S NOTES

Make a liter container with 5 squares, each the size of the square shown here.



Draw the squares on cardboard in this pattern.



Cut along the solid lines and fold on the dotted lines. Tape the sides together to form an open box. Fill the box with water or sand. The box has a capacity of about 1 liter.

Find other bottles, cans, or jars that can hold as much water or sand as the liter box.

Investigate whether 1 liter is more, less, or the same as 1 quart.

**

UNIT 49. MULTIPLICATION OF WHOLE NUMBERS

Reinforce multiplication facts developed in previous units. Develop facts for eights through 9 eights; for nines through 9 nines.

Observe and use the commutative property of multiplication.

Using the distributive property of multiplication over addition, extend multiplication beyond 9 sevens; 9 eights; 9 nines.

Suggestions for Pupil Activities

Adapt learning activities in Units 7, 15, 27, 35, 40, and 43.

Additional Suggestions

Use the commutative property of multiplication to develop facts for eights through 7 x 8; nines through 8 x 9.

If	8 x 2 = 16	If	9 x 2 = 18
Then	2 x 8 = ☐	Then	2 x 9 = ☐
	8 x 3 = 24		9 x 3 = 27
	so		so
	3 x 8 = ☐		3 x 9 = ☐
	.		.
	.		.
	.		.
	8 x 7 = 56		9 x 8 = 72
	so		so
	7 x 8 = ☐		8 x 9 = ☐

Use squared material or geoboards to illustrate the above.

Record gallon-pint relationship in table form.

Gallons	Pints
1	8
2	16
3	
4	
5	
6	
7	
8	

Write multiplication sentences that describe the relationship between gallons and pints.

1 x 8 = 8 2 x 8 = 16

TEACHER'S NOTES

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Unit 50. Division of Whole Numbers

Reinforce division facts developed in previous units. Develop facts for eights through the number of eights in 72; for nines through the number of nines in 81. Introduce division with a remainder.

Suggestions for Pupil Activities

Adapt learning activities in Units 8, 16, 28, 36,41, and 44.

Additional Suggestions

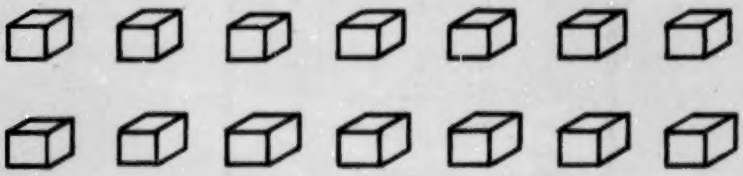
Introduce the concept of division as repeated subtraction. Show 36 cubes. Remove sets of nine. Describe the experience in the following form:

$$\begin{array}{rl} 36 & \text{cubes} \\ \underline{-\ 9} & \text{(1 set of nine)} \\ 27 & \text{cubes} \\ \underline{-\ 9} & \text{(2}^{\text{nd}}\text{ set of nine)} \\ 18 & \\ \underline{-\ 9} & \text{(3}^{\text{rd}}\text{ set of nine)} \\ 9 & \\ \underline{-\ 9} & \underline{\text{(4th set of nine)}} \\ 0 & \text{4 sets of nine in 36} \end{array}$$

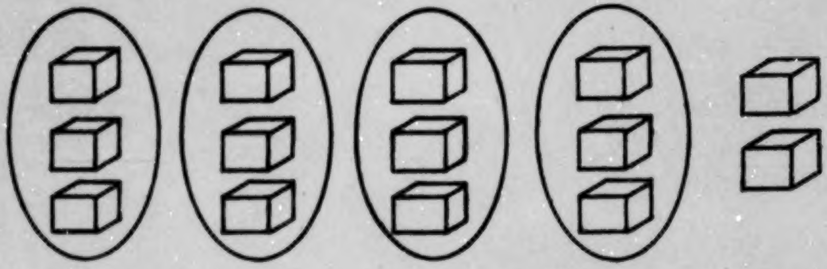
Repeat the activity for other products of 8 and of 9.

Introduce the concept of remainder in division. Use objects such as cubes, discs, bottle tops, clips, etc.

Show 14 cubes



Separate 14 cubes into sets (groups) of 3



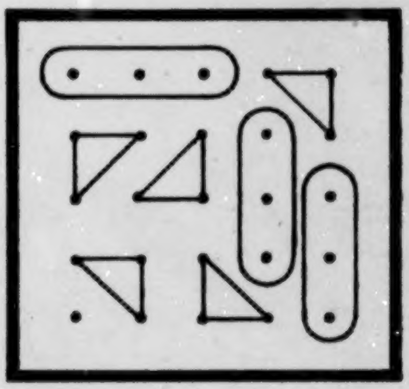
How many sets of three are there in 14?
There are 4 sets of 3 and 2 left.

Summarize by using the algorithm below.

$$\begin{array}{rl} 14 & \text{cubes} \\ -\underline{\;3} & \text{(1 set of 3)} \\ 11 & \\ -\underline{\;3} & \\ 8 & \\ -\underline{\;3} & \\ 5 & \\ -\underline{\;3} & \\ 2 & \text{cubes left} \end{array}$$

14 = 4 sets of 3 and 2 left

Investigate division with a remainder on a geoboard. Use rubberbands to separate 25 nails into set of three. (Substitute dot paper if geoboards are not available.)



How many threes in 25?

- Write mathematical sentences that describe the geoboard picture.

$$25 = 8 \text{ threes} + 1$$
$$25 = (8 \times 3) + 1$$
$$25 = 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 1$$

- Describe the division using an algorithm.

$$\begin{array}{rl} 25 & \text{nails} \\ -\underline{\;\;3} & \text{(1 set of 3)} \\ 22 & \\ -\underline{\;\;3} & \\ 19 & \\ -\underline{\;\;3} & \\ 16 & \\ -\underline{\;\;3} & \\ 13 & \\ -\underline{\;\;3} & \\ 10 & \\ -\underline{\;\;3} & \\ 7 & \\ -\underline{\;\;3} & \\ 4 & \\ -\underline{\;\;3} & \\ 1 & \text{nail left} \end{array}$$

Visualize division as repeated subtraction by using a calculator.

How many times do you subtract $\underline{3}$ from $\underline{24}$ to get $\underline{0}$ in the window? Record the results in the form of an algorithm.

***

Unit 51. Measurement: Temperature

Reinforce and/or develop the use of a thermometer to measure temperature. Introduce the term degree and symbol °. Measure temperature using Fahrenheit and Celsius thermometers.

SUGGESTIONS FOR PUPIL ACTIVITIES

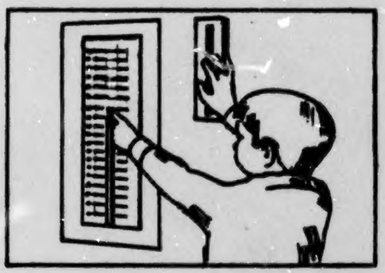
Make comparisons of temperature through personal experimentations such as:

- Place one finger in a pan of warm water, then quickly put it in a pan of cold water. Discuss how it feels.
- Stand in the sun and then in the shade. How does this feel?
- Place one hand in the sun and hold an ice cube in the other hand. Describe how you feel.

Initiate a sharing session and develop ideas such as:

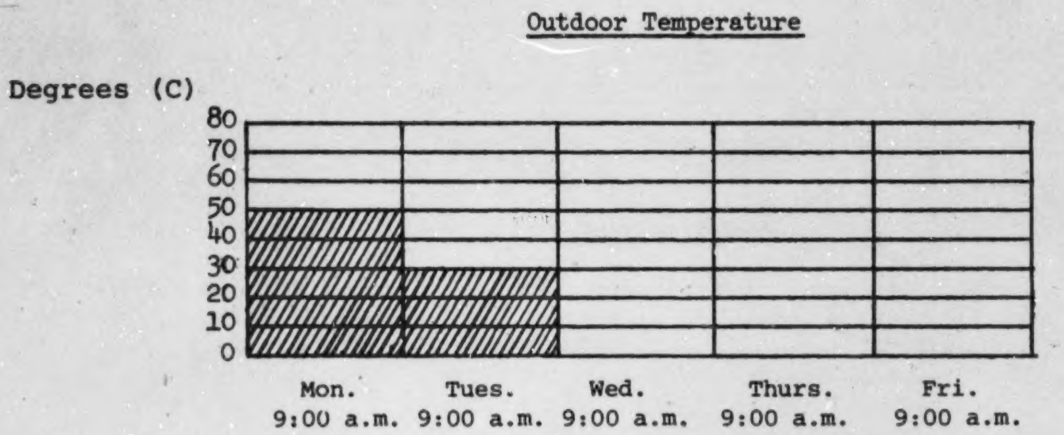
- Things feel different to different people. (Temperature is a relative thing.)
- Our "feeling" is not an efficient temperature indicator.
- Thermometers are used to measure temperature.
- The standard unit used for measuring temperature is degree: the symbol for degree is (°).

Examine different thermometers.



Count the markings on the scale and discuss the intervals. Introduce degree (°) as the standard unit used. Locate and read various temperatures such as: 20°, 40°, 14°, 72°, 19°, 2° below zero, 10° below zero.

Take the outdoor temperature each day at the same time. Record the data on a graph.



Discuss the:
- changes in the temperature
- highest temperature
- lowest temperature
- same temperature
- warmest day
- coolest day

TEACHER'S NOTES

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UNIT 52. NUMBER (OPTIONAL)

Use games and number lines to introduce the concept of negative number.

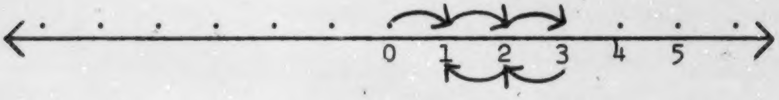
Suggestions For Pupil Activities

Adapt learning activities in Unit 51 to review the idea of below zero degrees and above zero degrees.

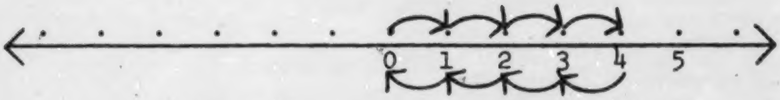
Additional Suggestions

Play number line games to develop the concept of negative numbers.

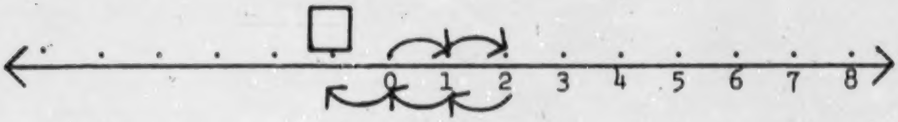
- Start at zero. Move 3 spaces to the right of zero. Name the stop number. Move 2 spaces to the left. Name the stop number.



- Start at zero. Move 4 spaces to the right of zero. Name the stop number. Move 4 spaces to the left. Where are you now?



- Start at zero. Move 2 spaces to the right. Name the stop number. Move 3 spaces to the left. What name would you give the stop number?



- Agree that the stop number may be called: "1 to the left of zero," "1 less than zero," etc. Record $^{-}1$ on the number line. Read it as "negative one."
- Continue the game so as to include $^{-}10$ on the number line.
- Discuss the idea that the negative numbers are to the left of zero and the positive numbers are to the right of zero on this number line.

**

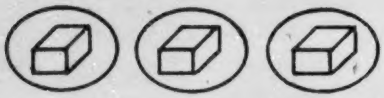
UNIT 53. MULTIPLICATION OF WHOLE NUMBERS

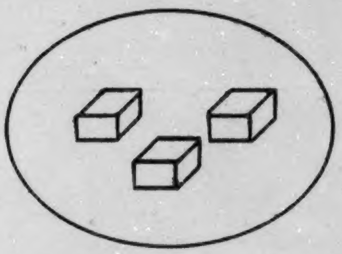
Develop an understanding of:

a. "1" as the identity element for multiplication
b. the role of zero in multiplication

Suggestions for Pupil Activities

Use objects to form sets (groups) of a specified number. Write multiplication sentences related to the sets of objects.





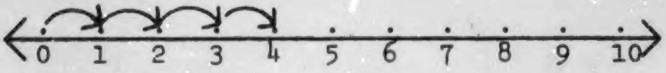
Demonstrate:

2 sets of 1 and 1 set of 2; 5 sets of 1 and 1 set of 5;
6 sets of 1 and 1 set of 6; 8 sets of 1 and 1 set of 8.

Discuss: What is the product when 1 is one of two factors?

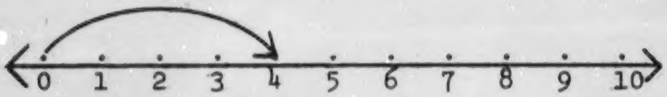
Use number lines.

4 jumps of 1



4 x 1 = 4

1 jump of 4



1 x 4 = 4

Repeat the activity using the following sets of factors:

(7, 1)   (8, 1)   (9, 1)

Discuss: What is the product when "1" is one of the factors?

Use a bag containing objects such as cubes, beans, pebbles, etc. Have children remove zero (no) objects three times. Record the number of objects removed each time. Write number sentences describing the activity.

0 + 0 + 0 = 0
3 x 0 = 0

Repeat the experience to lead to the following equations:

4 x 0 = 0   5 x 0 = 0   6 x 0 = 0
7 x 0 = 0   8 x 0 = 0   9 x 0 = 0

Discuss: What is the product when zero is one of the factors?

Apply the commutative property of multiplication.

Since 3 x 0 = 0   Then 0 x 3 = □
4 x 0 = 0   0 x 4 = □
5 x 0 = 0   0 x 5 = □
etc.

Discuss: What is the product when zero is one of the factors?

Present a series such as:

1 x 4 = ☐		4 x 1 = ☐		4 x 3 = ☐
1 x 3 = ☐		3 x 1 = ☐		3 x 3 = ☐
1 x 2 = ☐		2 x 1 = ☐		2 x 3 = ☐
1 x 1 = ☐		1 x 1 = ☐		1 x 3 = ☐
1 x 0 = ☐	Why?	0 x 1 = ☐	Why?	0 x 3 = ☐

Complete the open sentences. Examine the products and discuss the pattern (each product is 1 less than the previous one; in the last column each is 3 less than the previous one.)

TEACHER'S NOTES

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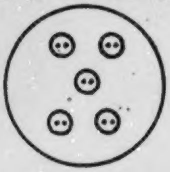
UNIT 54. DIVISION OF WHOLE NUMBERS

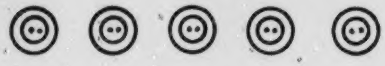
Develop an understanding of the role of "1" in division.

Suggestions for Pupil Activities

Use objects to form a set of 5.



Separate the set into subsets of one.



Relate the operation to the division sentence $5 \div 1 = 5$.

Repeat the experience and develop:

$$\begin{aligned} 2 \div 1 &= 2 \\ 3 \div 1 &= 3 \\ 7 \div 1 &= 7 \\ n \div 1 &= n \end{aligned}$$

Discuss: What is the quotient (answer) when any number is divided by 1?

Use the principle of inverse operations to explore division by "1."

2 x 1 = 2 so 2 ÷ 1 = ☐

3 x 1 = 3 so 3 ÷ 1 = ☐

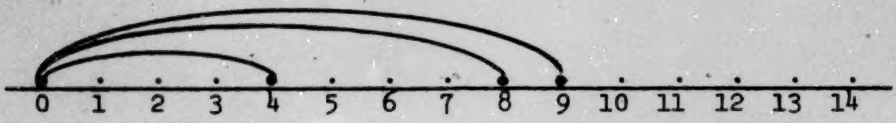
4 x 1 = 4 so 4 ÷ 1 = ☐

5 x 1 = 5 so 5 ÷ 1 = ☐

n x 1 = n so n ÷ 1 = ☐

Determine the pattern and complete the open sentences. Develop a generalization (rule) for dividing by "1."

Use a number line to visualize the concept that when any non-zero number is divided by itself the quotient is 1.



Start at 9. How many jumps of 9 to get to 0? (1)
Start at 8. How many jumps of 8 to get to 0? (1)
Start at 4. How many jumps of 4 to get to 0? (1)

List the responses as division sentences.

$9 \div 9 = 1$

$8 \div 8 = 1$

$4 \div 4 = 1$

$n \div n = \square$

Discuss: What is the quotient (answer) when a number is divided by itself?

**

UNIT 55. MULTIPLICATION OF WHOLE NUMBERS

Using the distributive property of multiplication over addition develop:

a. multiplying ten and multiples of 10 less than 100 by 2, 3, 4, ... 9

b. multiplying numbers through 50 by 2, 3, 4, ... 9.

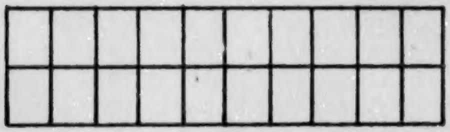
$$\begin{aligned} 2 \times 23 &= (2 \times 20) + (2 \times 3) \\ &= 40 + 6 \\ &= 46 \end{aligned}$$

$$\begin{array}{rl} 23 & \\ \times\ \underline{\ \ 2} & \\ 6 & (2 \times 3) \\ +\ \underline{40} & (2 \times 20) \\ 46 & \end{array}$$

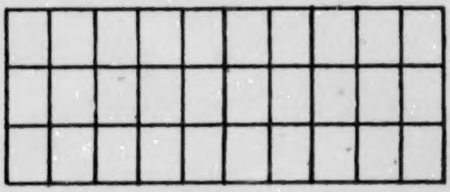
Suggestions for Pupil Activities

Name products when one of the factors is 10 or a multiple of 10.
Use graph paper to draw rectangles that enclose 10, 20, ... 90 squares.
Write multiplication sentences that describe each rectangle.

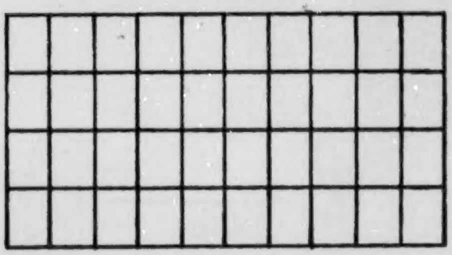
1 x 10 = 10



2 x 10 = 20



3 x 10 = 30



4 x 10 = 40

etc.

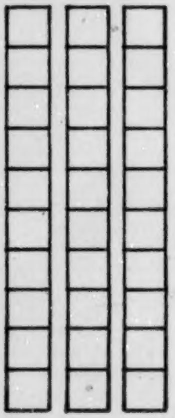
Determine the pattern in the series of rectangles and in the series of multiplication sentences. Develop the idea that the product of any whole number and a multiple of 10 has a zero in the ones place.

Write the equations in vertical form and discuss the pattern in the products.

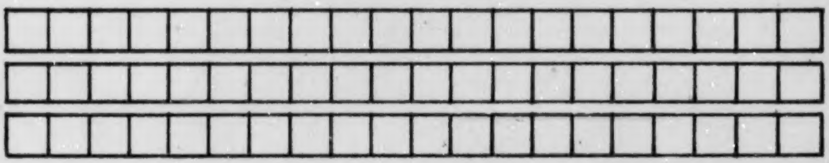
$$\begin{array}{r} 10 \\ \times\ \underline{\ \ 1} \\ 10 \end{array} \quad \begin{array}{r} 10 \\ \times\ \underline{\ \ 2} \\ 20 \end{array} \quad \begin{array}{r} 10 \\ \times\ \underline{\ \ 3} \\ 30 \end{array} \quad \begin{array}{r} 10 \\ \times\ \underline{\ \ 4} \\ 40 \end{array} \quad \begin{array}{r} 10 \\ \times\ \underline{\ \ 5} \\ 50 \end{array} \quad \cdots \quad \begin{array}{r} 10 \\ \times\ \underline{\ \ 9} \\ 90 \end{array}$$

$$\begin{array}{r} 1 \text{ ten} \\ \times\ \underline{1}\phantom{\text{ ten}} \\ 1 \text{ ten} \end{array} \quad \begin{array}{r} 1 \text{ ten} \\ \times\ \underline{2}\phantom{\text{ tens}} \\ 2 \text{ tens} \end{array} \quad \begin{array}{r} 1 \text{ ten} \\ \times\ \underline{3}\phantom{\text{ tens}} \\ 3 \text{ tens} \end{array} \quad \begin{array}{r} 1 \text{ ten} \\ \times\ \underline{4}\phantom{\text{ tens}} \\ 4 \text{ tens} \end{array} \quad \begin{array}{r} 1 \text{ ten} \\ \times\ \underline{5}\phantom{\text{ tens}} \\ 5 \text{ tens} \end{array} \quad \cdots \begin{array}{r} 1 \text{ ten} \\ \times\ \underline{9}\phantom{\text{ tens}} \\ 9 \text{ tens} \end{array}$$

Use interlocking cubes, bundles of ten, ten strips, multibase arithmetic blocks, or similar materials. Build sets of ten and multiples of 10. Write multiplication sentences that describe the sets.



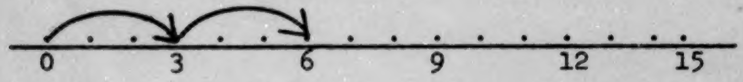
3 sets of 10 are 30
3 x 1 ten = 3 tens
3 x 10 = 30



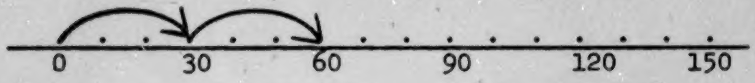
3 sets of 20 are 60
3 x 2 tens = 6 tens
3 x 20 = 60

Demonstrate the parallel between basic multiplication facts and multiplying multiples of ten by 2, 3, 4, ... 9.

- Use number ray illustrations.



2 x 3 = 6



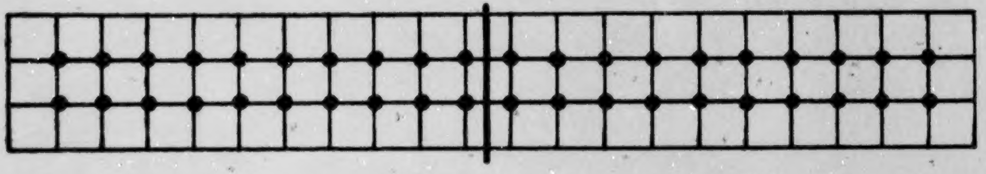
2 x 30 = 60

- Use repeated addition and relate to multiplication.

$$\begin{array}{r}2\\2\\2\\+\ 2\\\hline 8\end{array}\qquad\begin{array}{r}20\\20\\20\\+\ 20\\\hline 80\end{array}\qquad\begin{array}{r}6\\+\ 6\\\hline 12\end{array}\qquad\begin{array}{r}60\\+\ 60\\\hline 120\end{array}$$

$$\begin{array}{r}2\\\times\ 4\\\hline 8\end{array}\qquad\begin{array}{r}20\\\times\ 4\\\hline 80\end{array}\qquad\begin{array}{r}6\\\times\ 2\\\hline 12\end{array}\qquad\begin{array}{r}60\\\times\ 2\\\hline 120\end{array}$$

Visualize the use of the distributive property of multiplication over addition by using an array. Develop equations which describe the array.

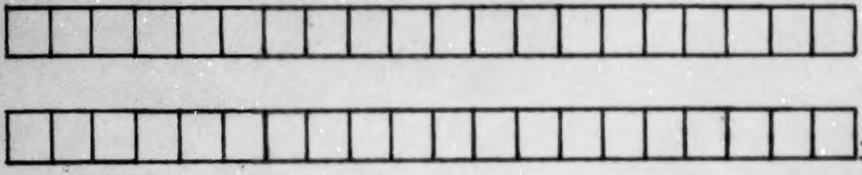


$$\begin{aligned}2 \times 20 &= (2 \times 10) + (2 \times 10)\\ &= 20 + 20\\ &= 40\end{aligned}$$

Find the products from known products.

We know: 1 x 20 = 20

Then: 2 x 20 = □



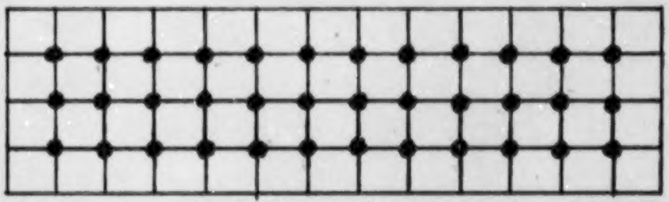
$$\begin{array}{r} 1 \times 20 = 20 \\ +\ 1 \times 20 = 20 \\ \hline 2 \times 20 = 40 \end{array}$$

Continue to add groups of twenty and lead to equations where one of the factors is 10 or a multiple of 10 less than 100.

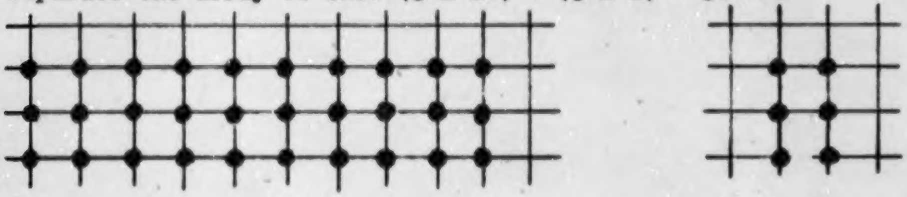
Use arrays to develop a procedure for multiplying numbers where one factor is greater than 10 and the other factor is less than 10, no regrouping.

For: 3 x 12 = □

- Form an array to show 3 x 12 = 36.



- Separate the array to show (3 x 10) + (3 x 2) = 30 + 6



3 x 10 = 30

3 x 2 = 6

30 + 6 = 36

$$\begin{array}{r} 10 \\ \times\ 3 \\ \hline 30 \end{array} \longleftarrow \text{Partial Product} \longrightarrow \begin{array}{r} 2 \\ \times\ 3 \\ \hline 6 \end{array}$$

$$\begin{array}{r} 30 \\ +\ 6 \\ \hline 36 \end{array}$$

Refer to the materials and summarize the steps in the form of a vertical algorithm.

$$\begin{array}{r} 1 \text{ ten} \\ \underline{\times\ 3}\phantom{\text{ ten}} \\ 3 \text{ tens} \end{array} \qquad \begin{array}{r} 2 \text{ ones} \\ \underline{\times\ 3}\phantom{\text{ ones}} \\ 6 \text{ ones} \end{array} \longrightarrow \begin{array}{r|l} \text{Tens} & \text{Ones} \\ \hline 1 & 2 \\ \times\ \ & 3 \\ \hline 3 & 6 \end{array} \longrightarrow \begin{array}{r} 12 \\ \underline{\times\ 3} \\ 36 \end{array}$$

$$\begin{array}{r} 10 \\ \underline{\times\ 3} \\ 30 \end{array} \qquad \begin{array}{r} 2 \\ \underline{\times\ 3} \\ 6 \end{array} \longrightarrow \begin{array}{r|l} \text{Tens} & \text{Ones} \\ \hline 1 & 2 \\ \times\ \ & 3 \\ \hline 3 & 6 \end{array} \longrightarrow \begin{array}{r} 12 \\ \underline{\times\ 3} \\ 36 \end{array}$$

Repeat for $2 \times 23 = \square$ $\quad 4 \times 21 = \square$ $\quad 3 \times 11 = \square$
and other similar multiplications where no regrouping is necessary.

**

UNIT 56. ADDITION OF WHOLE NUMBERS

Develop skill in column addition with exchange. Use word problems and dollars and cents.

Suggestions for Pupil Activities

Adapt learning activities in Units 4, 22, 23, 24, 45, and 47.

Additional Suggestions

Keep records of daily attendance, monies collected for G.O., parties, trips, etc.

Attendance for the Week of ___________

	Girls	Boys	Total
Mon.	15	14	29
Tues.	16	19	35
Wed.	13	19	32
Thurs.			
Fri.			

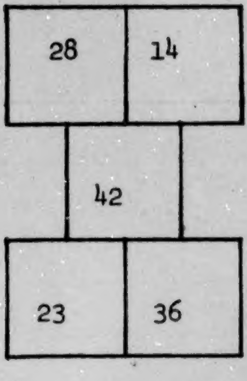
Develop and solve word problems relevant to the data pictured above.

- How many girls were present on Monday, Tuesday, and Wednesday? How many boys?

- What was the total attendance for the five days?

TEACHER'S NOTES

Play games which involve keeping score.



Find the total score of three or more throws of a bean bag or a bottle top on a target.

	Peter
First throw	14
Second throw	23
Third throw	+ 36
Score	73

**

UNIT 57. SUBTRACTION OF WHOLE NUMBERS

Develop skill in subtracting numbers less than 1000 where two regroupings are necessary, exchanging 1 hundred for 10 tens, and 1 ten for 10 ones.

Suggestions for Pupil Activities

Adapt learning activities in Units 23, 25, and 33.

Additional Suggestions

Use the expanded form to compute differences where 2 regroupings are necessary.

$$\text{For:}\quad \begin{array}{r} 463 \\ -\ \underline{285} \end{array}$$

. Rename numbers by making number sentences true.

463 = 400 + ☐ + 3
463 = 400 + 50 + ☐
463 = 300 + ☐ + 3
463 = 300 + ☐ + 13

. Compute

$$\begin{array}{r} 400 + 60 + 3 \\ -\ \underline{200 + 80 + 5} \end{array} \rightarrow \begin{array}{r} 400 + 50 + 13 \\ -\ \underline{200 + 80 + \ 5} \\ 8 \end{array}$$

Are there enough ones to subtract 5 ones?
Regroup 6 tens as 5 tens + 10 ones, thus changing 60 to 50 and 3 to 13.
Subtract the ones (13-5).
Record the 8 in the ones place.

$$\begin{array}{r} 400 + 50 + 13 \\ -\ 200 + 80 + 5 \\ \hline 8 \end{array} \rightarrow \begin{array}{r} 300 + 150 + 13 \\ -\ 200 + 80 + 5 \\ \hline 100 + 70 + 8 \end{array} = 178$$

Are there enough tens to subtract 8 tens?
Regroup 4 hundreds as 3 hundreds + 10 tens, thus changing 400 to 300 and 50 to 15 tens or 150.
Subtract the tens.
Record the tens.
Subtract the hundreds.
Record the 100.
Rename 100 + 70 + 8 as 178.

Develop the standard form.

For: $\begin{array}{r} 463 \\ -\ 285 \\ \hline \end{array}$

- Determine that it is necessary to regroup twice (tens as ones and hundreds as tens).

- Regroup tens as ones and subtract the ones (13-5)

Hundreds	Tens	Ones
	5	13
4	$\cancel{6}$	$\cancel{3}$
- 2	8	5
		8

- Regroup hundreds as tens and subtract the tens (15 tens - 8 tens)

Hundreds	Tens	Ones
3	15	13
$\cancel{4}$	$\cancel{5}\cancel{6}$	$\cancel{3}$
- 2	8	5
	7	8

- Subtract hundreds (3 hundreds - 2 hundreds)

Hundreds	Tens	Ones
3	15	13
	$\cancel{5}$	
$\cancel{4}$	$\cancel{6}$	$\cancel{3}$
- 2	8	5
1	7	8

$$\begin{array}{r} {}^{3}\,{}^{15} \\ \cancel{4}\,\cancel{6}\,{}^{1}3 \\ -\ 285 \\ \hline 178 \end{array}$$

NOTE: Some pupils may need to use small numerals to indicate the regrouping.

**

UNIT 58. MULTIPLICATION OF WHOLE NUMBERS

Reinforce multiplication of numbers 10 through 99 by numbers less than 10.

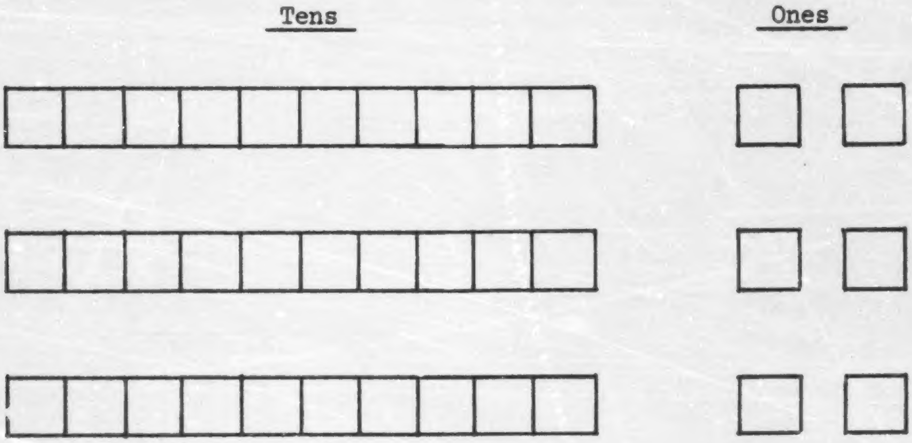
Suggestions for Pupil Activities

Adapt learning activities in Unit 53.

Additional Suggestions

Use place value materials such as bundles of ten interlocking cubes, colored rods, squared materials, and multibase arithmetic blocks to explore ways of computing products.

Show 3 sets of 12 (3 x 12) and write a multiplication sentence for the tens and for the ones.



3 tens = 30	3 twos = 6
3 x 10 = 30	3 x 2 = 6

$$\begin{array}{r} 10 \\ \times\ \ 3 \\ \hline 30 \end{array} \qquad \qquad \begin{array}{r} 2 \\ \times\ 3 \\ \hline 6 \end{array}$$

Refer to the materials and develop algorithms.

Expanded Form

- $$\begin{array}{r} 12 \\ \times\ \ 3 \\ \hline 36 \end{array}$$ Determine that 12 is shown as 3 times 10 + 2. $$\begin{array}{r} 10 + 2 \\ \times\qquad 3 \\ \hline \end{array}$$

- $$\begin{array}{r} 10 + 2 \\ \times\qquad 3 \\ \hline 30 + 6 = 36 \end{array}$$ What is 3 x 2?
What is 3 x 10?
What is 30 + 6?

Place Value Form

- Multiply ones (3 x 2)
Record the 6 in the ones place

$$\begin{array}{c|c} \text{Tens} & \text{Ones} \\ \hline 1 & 2 \\ \times & 3 \\ \hline & 6 \end{array}$$

- Multiply tens (3 x 1 ten or 3 x 10)
30 is 3 tens + 0
Record the 3 in the tens place

$$\begin{array}{c|c} \text{Tens} & \text{Ones} \\ \hline 1 & 2 \\ \times & 3 \\ \hline 3 & 6 \end{array}$$

Eliminate the place value words and multiply, using the short form.

$$\begin{array}{r} 12 \\ \times\ \ 3 \\ \hline 36 \end{array}$$

Partial Product Form

Multiply tens first

$$\begin{array}{rl} 12 & \\ \times\ \ 3 & \\ \hline 30 & (3 \times 10) \\ 6 & (3 \times 2) \\ \hline 36 & \end{array}$$

Multiply ones first

$$\begin{array}{rl} 12 & \\ \times\ \ 3 & \\ \hline 6 & (3 \times 2) \\ 30 & (3 \times 10) \\ \hline 36 & \end{array}$$

Relate the partial product form to the short form.

$$(3 \times 10) \longleftarrow \begin{array}{r} 12 \\ \times\ \ 3 \\ \hline 36 \end{array} \longrightarrow (3 \times 2)$$

Use place value materials to develop algorithms where the product of the ones **is** greater than ten. (Regrouping ones for tens)

Partial Product Form

	Tens	Ones
	1	8
x		2
	1	6 (2 x 8)
	2	0 (2 x 10)
	3	6 (2 x 18)

Multiply the ones
16 is 1 ten + 6 ones
Record the 16

Multiply the tens (2 x 10)
20 is 2 tens + 0 ones
Record the 20

Add 16 + 20 (partial products)
2 x 18 = 36

Relate the partial product form to the short form.

$$\begin{array}{rl} 18 & \\ \times\ \underline{2} & \\ 16 & (2 \times 8) \\ \underline{20} & (2 \times 10) \\ 36 & \end{array} \Bigg\} \rightarrow \begin{array}{r} 18 \\ \times\ \underline{2} \\ 36 \end{array}$$

Multiply the ones (2 x 8 = 16)
16 = 1 ten + 6 ones
Record the 6 in the ones place
Multiply the tens (2 x 1 ten = 2 tens)
2 tens + 1 ten = 3 tens or 30
Record the 3 in the tens place

**

UNIT 59. MULTIPLICATION OF WHOLE NUMBERS

Use the distributive property of multiplication over addition to develop patterns when multiplying by numbers greater than 9.

Suggestions for Pupil Activities

Adapt the last activity in Unit 55 to the following series.

A	B	C
10 x 2 = 20	10 x 2 = 20	10 x 3 = 30
20 x 2 = 40	20 x 2 = 40	11 x 3 = 33
30 x 2 = 60	40 x 2 = 80	12 x 3 = 36
40 x 2 = □	80 x 2 = □	13 x 3 = 39
50 x 2 = □	160 x 2 = □	14 x 3 = □

Discuss the relationship between the first factor and the product.

What is the difference between each pair of factors, e.g., between 10 and 20, 20 and 30, 30 and 40, etc.?

What is the difference between each pair of products, e.g., between 20 and 40, 40 and 60, etc.?

Derive a generalization (rule) for each series.

For Series C: If 10 x 3 = 30
Then 11 x 3 = (10 x 3) + (1 x 3)

OR

If 10 x 3 = 30
Then 11 x 3 = 30 + 3 or 33

**

UNIT 60. DIVISION OF WHOLE NUMBERS

Continue to develop procedures for recording the relationship between division and repeated subtraction.

Divisors: numbers less than 10
Dividends: numbers less than 100

Suggestions for Pupil Activities

Use the procedures developed in Unit 50 to find the quotient of 48 ÷ 2. Then record 2) 48 on the chalkboard. Ask: How many sets of twos are there in 48? Solve the problem in a variety of ways according to the children's suggestions. For example:

Method 1

```
  24
2)48
 - 8  (4 x 2)
  40  still to divide
- 10  (5 x 2)
  30  still to divide
- 10  (5 x 2)
  20  still to divide
- 20  (10 x 2)
   0    24 x 2
```

How many twos were subtracted the first time, the second time, and so on?
How many twos were subtracted in all?
How many twos are there in 48?
There are 24 twos in 48.

Method 2

```
  24
2)48
- 18   9 (sets of 2)
  30
- 18   9 (sets of 2)
  12
- 12   6 (sets of 2)
   0  24 (sets of 2)
```

How many twos were subtracted in all?
24 twos in 48

Method 3

```
   24
2)48  |
 -20  |   10
  28  |
 -20  |   10
   8  |
 - 8  |    4
   0  |__ 24
```

Method 4

```
   24
2)48  |
 -40  |   20
   8  |
 - 8  |    4
   0  |__ 24
```

How many twos were subtracted in all?
24 twos in 48

24 twos in 48

Compare the various recordings. Are the quotients (answers) the same? Why is Method 4 the shortest way?

Conclude: The greater the multiples of the divisor that are subtracted, the shorter the computation.

Investigate how to divide on a desk calculator. How many times is 2 subtracted from 48 to get 0 in the window?

*

UNIT 61. NUMERATION

Use materials such as squared materials, bundles of sticks, centimeter graph paper, abacus, multibase arithmetic blocks, to:

a. reinforce place value to

H	T	O
9	9	9

b. introduce place value to thousands

Th	H	T	O
1	0	0	0

c. count by thousands to 10 thousands

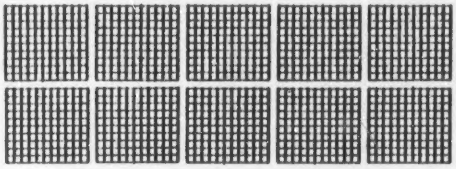
d. read and write numerals for numbers to 10,000

Suggestions for Pupil Activities

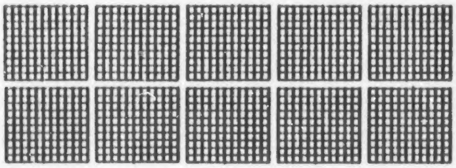
Adapt learning activities in Units 12 and 20.

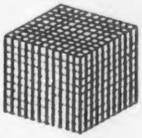
Additional Suggestions

Organize representations of 100 to demonstrate counting by hundreds to 10 hundreds.



1 hundred, 2 hundreds, 3 hundreds, ..., 10 hundreds





10 hundreds = 1 thousand

Name 1 thousand on a place value chart.

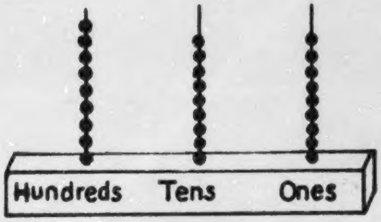
Thousands	Hundreds	Tens	Ones
1	0	0	0

Discuss the 4-digit numeral 1000 in terms of another name for 1 thousand, 10 hundreds, and 10 times one hundred.

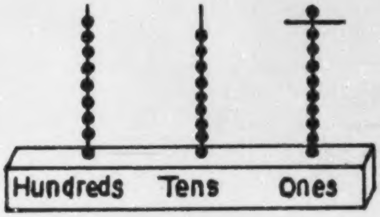
Use the same idea to build models of 2 thousands, 3 thousands, 4 thousands, ... 9 thousands and record the 4-digit numerals on the place value chart.

Investigate place value to 1000 on an abacus.

- Show 999 on an abacus.

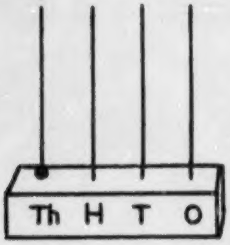


- Represent 1 more than 999 or 1000 on the abacus by placing one more bead in the ones column.



- Discuss regrouping 10 ones for 1 ten
  10 tens for 1 hundred
  10 hundreds for 1 thousand

- Show and read 1000 as "one thousand."

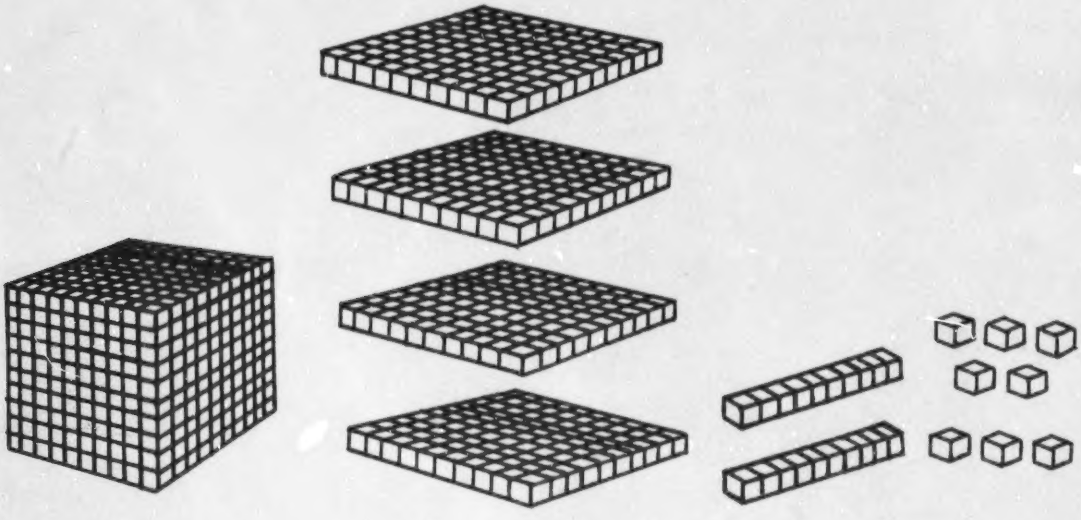


- Record the numeral 1000 on a place value chart.

Thousands	Hundreds	Tens	Ones
1	0	0	0

Use the abacus to represent numbers greater than 1000.

- Build representations of numbers to 9,999.



1 thousand 4 hundreds 2 tens 8 ones

Write numerals for the numbers represented on a place value chart.

Thousands	Hundreds	Tens	Ones
1	4	2	8

Translate the numerals on the place value chart into standard numerals, e.g., 1428.

Read 1428 as one thousand, four hundred twenty-eight.

Investigate how a desk calculator goes from 999 to 1000. Compare this method with the abacus representations of numbers. Discuss similarities and differences.

TEACHER'S NOTES

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UNIT 62. OPERATIONS: FRACTIONAL NUMBERS

Reinforce finding $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{3}$, $\frac{1}{6}$ of whole numbers, no remainders.

Using activities and materials, develop finding non-unit fractional parts of whole numbers, e.g., $\frac{2}{3}$ of 6 lollipops.

Suggestions for Pupil Activities

Adapt learning activities in Units 10, 30, and 38.

Additional Suggestions

Cut ribbon, string, oaktag, or other similar materials into pieces 1 foot long or 12 centimeters long. Explore ways of finding the number of inches or centimeters in $\frac{1}{2}$ the strip; in $\frac{1}{4}$ the strip; in $\frac{1}{3}$ the strip.

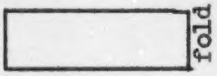
-

  Ribbon 12 centimeters long

- Fold to show halves.

  Ribbon 6 centimeters long

- Fold to show fourths.

  Ribbon 3 centimeters long

- Fold to show thirds: Ribbon 4 centimeters long.

Discuss the results and record.

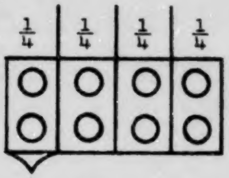
$\frac{1}{2}$ of 12 cm = 6 cm
$\frac{1}{2}$ of 12 = 6

$\frac{1}{4}$ of 12 cm = 3 cm
$\frac{1}{4}$ of 12 = 3

$\frac{1}{3}$ of 12 cm = 4 cm
$\frac{1}{3}$ of 12 = 4

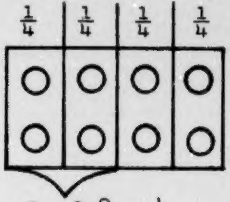
Develop a procedure for solving problems such as $\frac{2}{4}$ of 8 = $\square$; $\frac{3}{4}$ of 8 = $\square$

- Separate 8 objects into fourths. Name each part. Determine that $\frac{1}{4}$ of 8 = 2.



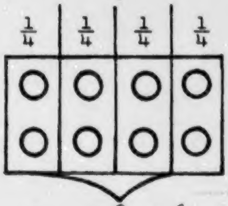
$\frac{1}{4}$ of 8 = 2

- Identify two fourths of the set of objects. Count the number of objects. Determine that $\frac{2}{4}$ of 8 = 4.



$\frac{2}{4}$ of 8 = 4

- Identify three fourths of the set of objects. Count the number of objects. Determine that $\frac{3}{4}$ of 8 = 6.



$\frac{3}{4}$ of 8 = 6

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UNIT 63. MULTIPLICATION OF WHOLE NUMBERS

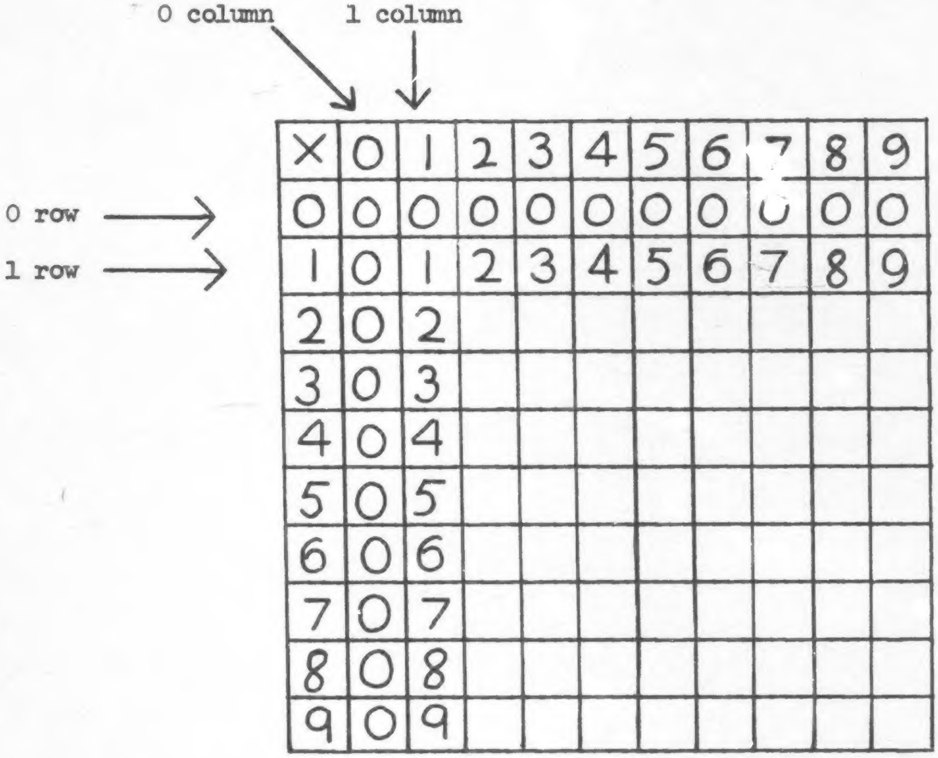
Construct a multiplication table through 9 nines to reinforce multiplication facts. Use the table to explore patterns in multiplication.

Suggestions for Pupil Activities

Adapt learning activities in Units 27 and 43 to construct multiplication table.

Additional Suggestions

Use 1-inch square graph paper, acetate for the overhead projector, or other similar materials to construct a table.


0 column
1 column
0 row
1 row

X	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2								
3	0	3								
4	0	4								
5	0	5								
6	0	6								
7	0	7								
8	0	8								
9	0	9								

Complete the 0 row. Complete the 0 column. Conclude that when zero is one of the factors the product is zero.

Complete the 1 row. Complete the 1 column. Observe the identity element of multiplication.

Complete the table. Determine the counting pattern in each row and in each column.

Use a completed multiplication table. Locate products that are repeated. Name the factors.

Product	24			
Factors	(6, 4)	(4, 6)	(8, 3)	(3, 8)

Observe the commutative property of multiplication.

Investigate patterns of even and odd products. Locate even products. Are the factors odd or even? Locate odd products. Are the factors odd or even?

Develop a chart to organize the information.

X	Odd	Even
Odd	Odd	Even
Even	Even	Even

***

UNIT 64. MEASUREMENT: SPEED (OPTIONAL)

Develop an understanding of rate-time-distance relationship.

Suggestions for Pupil Activities

Use a stop watch or a clock. Find out how far each child walks in one minute; runs in one minute.

	Walked in 1 Minute	Ran in 1 Minute
Harry	3 times around the room	5 times around the room
Gail	2 1/2 times around the room	3 1/4 times around the room
Thomas	2 1/2 times around the room	4 times around the room
Jean	2 times around the room	3 1/2 times around the room

Discuss: How far did each child walk in one minute?
Who covered the greatest distance? Why?
How far did each child run in one minute?
Who covered the greatest distance? Why?

Conclude: The greater the speed the greater the distance covered within a specified period of time.

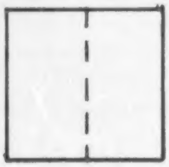
***

UNIT 65. GEOMETRY: SYMMETRY

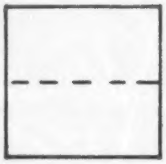
Experiment with materials to discover and recognize symmetrical patterns.

Suggestions for Pupil Activities

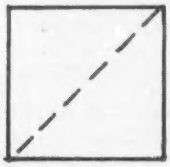
Use the geometric figures constructed in Unit 34. Explore ways of folding so that one half matches the other half.



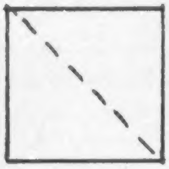
one way



another way



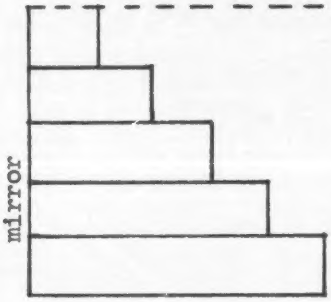
another way



another way

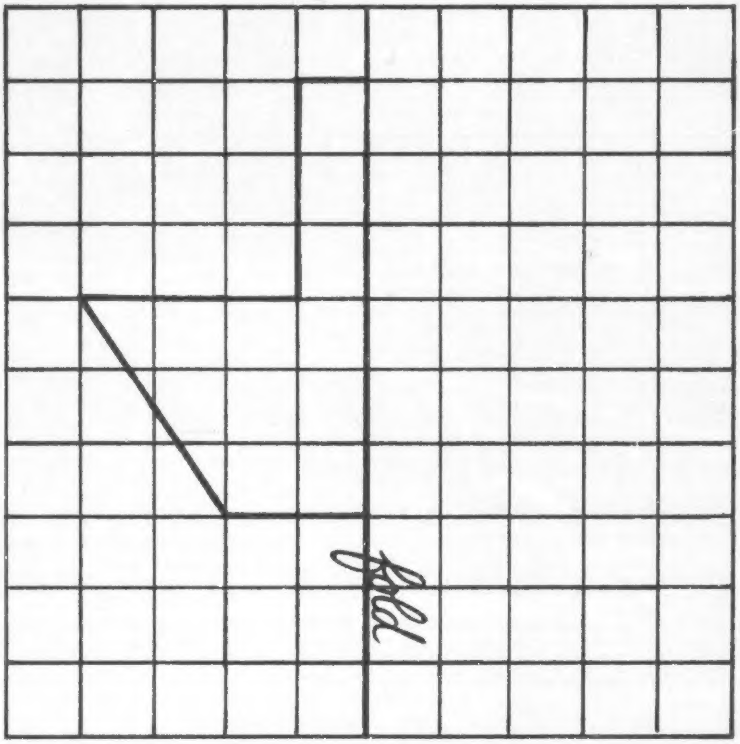
Discuss the folds as lines of symmetry.

Build patterns with blocks, colored rods, or other similar materials. Place a mirror along one side. Use the same material to build the image seen in the mirror.

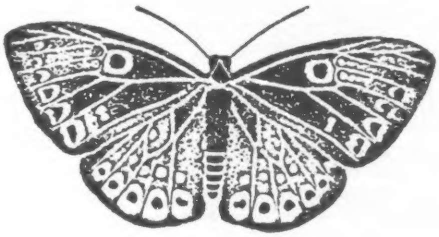


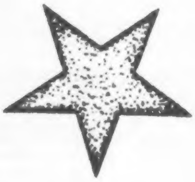
Discuss the possible line of symmetry.

Fold a piece of graph paper in half. Draw a figure in the left half. Draw a mirror image in the other half. Discuss the different ways of completing the figure.



Make a collection of symmetrical objects. Identify the line or lines of symmetry in each object.





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UNIT 66. PROBABILITY (OPTIONAL)

Develop understanding of the outcome in a two-possibility event as one choice out of two; one chance in two, for example, each time a coin is tossed, the chance of heads turning up is one chance out of two.

Suggestions for Pupil Activities

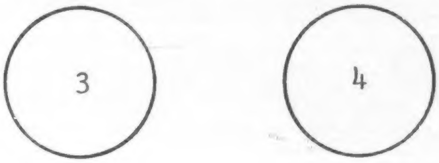
Toss a coin ten times. Tally the results on a chart.

Heads	Tails
~~1111~~ 11	111

Discuss: How many times did heads turn up?
How many times did tails turn up?
Guess which side will turn up if the coin is tossed again?
Can you be sure of the result? Why?
Was the guess correct?

Predict what will happen if a coin is tossed twenty times, then thirty times. Record and compare the results.

Place 2 discs with different numerals in an opaque bag.



Experiment to find out what the chances are of pulling out the 3 disc first; of pulling out the 4 disc first.
